THE MONTHLY

Review

Important Notice

The official program of the A. E. S. Convention will be mailed the first week in June. Because of shortage please bring your copy with you to the Convention.

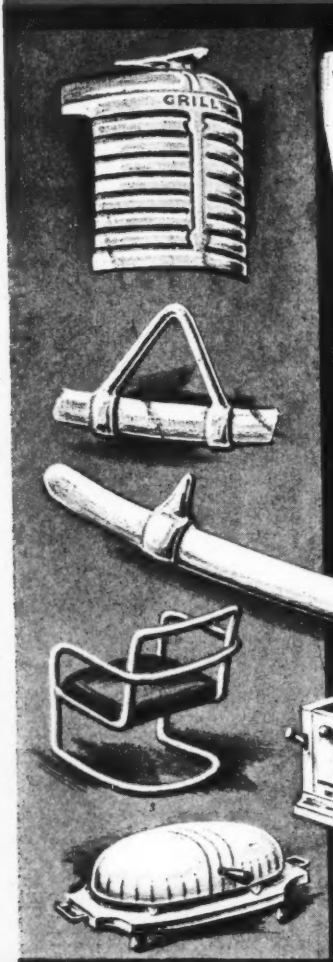
Official Organ of the American Electroplaters' Society
A Society for the Advancement of the Science of Electroplating

MAY • • • 1946

BUFFING COMPOUNDS REMOVED

By MOLECULAR BOMBARDMENT

Prior to Bright-Nickel-Plating



FAST POSITIVE REMOVAL OF BUFFING RESIDUES FROM BUFFED COPPER-PLATED ARTICLES WITH CLEPO MOLEX PROCESS.

This process operates on the principle of molecular bombardment by the solution of Clepo Compounds upon Buffing Compounds which are usually caked against the Base Metal.

The Clepo Laboratories have been working on the development of the Clepo MOL-EX Process for over five years, and in actual use it has proved to be the perfect method for cleaning buffed copper-plated parts prior to bright nickel plating.

A Booklet of technical data has been published and a complimentary copy is now available upon request. If you prefer, we can ship to your plant immediately, sufficient Clepo Compounds for a Production Trial. Our service representative will supervise the operation if you so wish.

Cleaning of Buffed Copper-Plated Articles is but one application of this Process. Others are:

1. Cleaning of Steel prior to Bright Nickel Plating.
2. Cleaning of Buffed brass parts prior to Bright Nickel Plating.
3. Cleaning of Zinc-base die castings prior to Copper Plating.
4. Cleaning of Steel prior to Zinc or Cadmium Plating.

FREDERICK **GUMM** *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N. J.

Cleaning before BRIGHT ZINC PLATING

SERVICE REPORT

FREE *6-page report on specialized Oakite Surface Preparation Methods*

WHEN ferrous parts are to be given a bright zinc plated finish, the first and VITAL step is thorough removal of grease, dirt and other foreign matter. Surfaces MUST be CHEMICALLY CLEAN to insure a uniform, lasting finish.

WHETHER you are presently using a still or soaker tank, an electrocleaning tank, an automatic mechanical washing machine or a combination of any of these, you will find Oakite degreasing and cleaning materials rapidly remove grease, machine oils, drawing lubricants, stamping compounds and other deposits. Fast working, they do the job thoroughly, safely . . . leave surfaces unharmed.

Send for Your FREE Copy

When you write for your FREE copy of this helpful publication, mention any PARTICULAR cleaning problem you may have, the chances are that we can help you. Let us give you the benefit of our wide knowledge on surface preparation before ALL finishing operations.

OAKITE PRODUCTS, INC., 40 Thames St., NEW YORK 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* CLEANING
MATERIALS · METHODS · SERVICE · FOR EVERY CLEANING REQUIREMENT

Cut Costs
Get Bright Deposits
Speed Operation

with these

DU PONT ZINC PLATING CHEMICALS!

DU PONT "ZIN-O-LYTE" zinc plating

zinc deposits direct from the bath without bright dipping!

DU PONT "DUROBRITE" zinc plating

of steel.

zinc plating

zinc deposits direct from the bath *without bright dipping!*

- baths are easily made up from prepared salts.
- suitable for all types of zinc plating, particularly barrel plating.
- satisfactory for use with almost all types of ferrous metals.

zinc plating

readily applied on almost all types of steel.

- bath made up easily with standard low-cost chemicals.
- easy to operate and control—gives good results over a wide range of operating conditions.
- rapid rate of deposition over wide operating range.

DU PONT

CHEMICALS • PROCESSES • SERVICE

for **ELECTROPLATING**

DU PONT

REG. U.S. PAT. OFF.

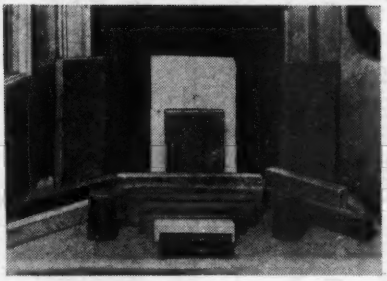
BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY

OPERATING MANUALS

on "Zin-O-Lyte" for zinc plating and on "Durobrite" for zinc plating. Packed with facts on faster, more economical operation! Write today for your copies. Just address E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

Stevens

STEVENS SPECIAL SIZE CAKES



FOR AUTOMATIC COMPOUND FEEDERS

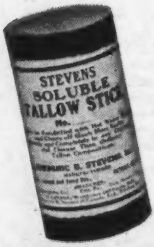
When cakes are clamped in mechanical holders there is a terrific strain on the compound when it hits the buff. This may cause breakage and injury to the operator or damage to the machine.

You can avoid this danger by using Stevens Special Size Cakes, which have a tough, strong texture—perfectly flat and parallel faces and uniform dimensions.

The large white cake at rear of picture is Stevens Stainless Steel. The cake is 12″ x 12″ x 18½″ and weighs over thirty pounds. The little "sliver" at front is Stevens Tripoli. This cake is ¾″ x 1½″ x 7½″ and weighs but eight ounces.

(ATOMIZED)

Stevens SPRAY-BUFF *Compounds*



Liquefied Buffing and Polishing Compounds are "old stuff" to us. We have manufactured and sold them for many years. They have been applied in different ways—including brushing, dripping, spraying, etc., both hot and cold.

Recent developments in Spraying Equipment have made the use of such compounds in buffing and polishing various metals such as brass, aluminum, stainless steel, nickel plate, etc., both practical and economical.

Complete Compressed Air Spraying Equipment—including pressure tanks, valves, and spray guns—with all necessary recommendations for use—have been added to the Stevens Line and are now available.

Write for information or ask the Stevens salesman at our nearest Branch Office.

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• NEW YORK and PENNSYLVANIA 37 Stone St., Buffalo, N. Y.
• INDIANA Hoosier Supply Co., 76 S. Delaware St., Indianapolis, Ind.
• CANADA 1261 McDougall St., Windsor, Ontario
• 2165 Dundas St. West, Toronto, Ontario
FREDERIC B. STEVENS OF CANADA, LIMITED

BUFFING COMPOSITIONS • METAL POLISHERS AND ELECTROPLATERS SUPPLIES-EQUIPMENT

THE MONTHLY

Review

VOLUME 33 • MAY • NUMBER 5

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$.50 per Copy

Entered as second class matter September 14, 1945, at the post office at Paterson, N. J., under Act of August 24, 1912.

Color and Blacken Metals

TO PROTECT AND BEAUTIFY YOUR PRODUCTS

ALUMON

A simple dip process for preparing aluminum alloys for electroplating. Now, plentiful aluminum can be given beautiful finishes—gold, silver, nickel, chrome and metal oxidized finishes. One or two Enthone solutions added to your plating department will enable you to plate upon aluminum.

ALUMOX

A new chemical process for oxidizing aluminum to make an ideal base for organic finishes. No electric current is used. A dip in the warm Alumox solution for a few minutes is merely required. The grey-green iridescent finish is beautiful and durable in itself. It can be relieved by buffing or wire brushing to give attractive color contrast. Process cost less than one cent per square foot of aluminum treated. For buttons, buckles, eyelets, trays, vases, compacts, dress ornaments and for large objects where high paint adhesion is required.

EBONOL "C"

(U S. Patent No. 2,364,993) A process easily operated for blackening and coloring copper. brass and other copper alloys. Cupric oxide finish; stable, adherent and protective. Operating temperature 210° to 218°F

EBONOL "S"

A simple, one-way bath, easy-to-operate process for blackening and coloring iron and steel with a ferroferric oxide coating. Low operating temperature, 285-290°F

EBONOL "Z"

A blackening process for zinc and zinc alloys. Operated without expensive supervision. Coating is very stable and is an excellent base for organic finishing.

METAL COLOR PROCESS

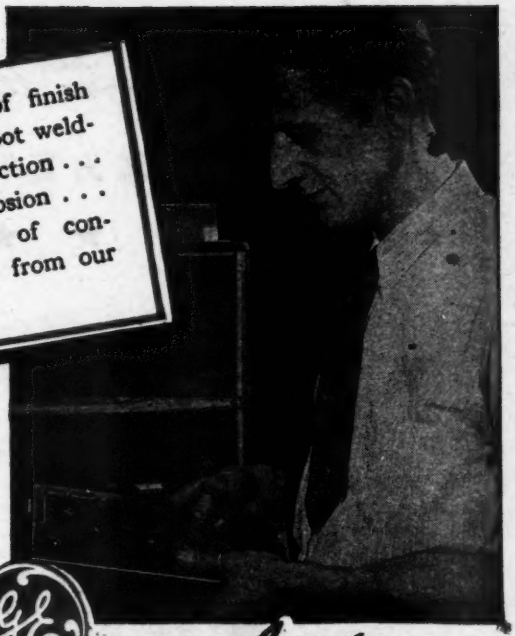
This new process brings fresh eye-appeal to liven standard products. Colors are produced on Brass and Copper by oxidation at low temperature to give stable, adherent colors – *Yellow, Blue, Blue-Green, Old English, Statuary Bronze, Brown* and *Black*. The process works well on electro-plated brass, thus permitting the coloring of steel and other metals that can be brass plated. Treating cycles are short and bulk work can be processed in baskets or tumbling barrels.

■ *Literature available on all processes. Customer's samples finished and technical advice offered.*

Free!
New Four Color Brochure on Enthone Metal Coloring Process.

ENTHONE
METAL COLORING PROCESSES

"Pleasing brilliancy of finish . . . no difficulty in spot welding . . . speeds production . . . protection from corrosion . . . greater expectancy of continued good service from our radios."



Excerpts from statement of
Paul L. Chamberlain
Manager of Sales
Receiver Division
GENERAL ELECTRIC COMPANY

That's why G-E uses *Luster-on* in its 1946 Radio Line!

The words quoted above are not ours. They are facts stated by a Luster-on* user! They sum up the reasons why the Sales and Engineering Departments at General Electric chose Luster-on* as the protective bright dip for chassis, speaker shells, and other zinc-plated radio parts — why Luster-on* looks like *good business* to G-E!

In the photograph, E. G. Anderson, G-E Methods Department, holds a Luster-on* treated chassis. He knows it is safe from fingermarks and discolorations during assembly — will retain its attractiveness — keep buyers happier. And best of all Luster-on* may now be used in the standard full-automatic plating cycle without delayed action transfer.

Send a sample of your zinc-plated production parts for free Luster-on* treatment. It can mean *good business* for *you*, too

*Patent applied for

THE *Chemical* CORPORATION
54 Waltham Ave., Springfield 9, Mass.

THE CHEMICAL CORPORATION
54 Waltham Ave., Springfield 9, Mass.

Please send me full particulars about Luster-on* bright dip for zinc surfaces. I am (am not) sending sample part for free dip. No obligation, of course.

Name.....

Address.....

Monthly Review — May

Our Shoulder

TO KEEP YOUR

★ ★ ★ ★ ★ ★ ★ ★ ★

FACTORY & GENERAL OFFICE • 711 WEST LAKE STREET

To the Wheel . . .

PLANT ROLLING

★ ★ ★ ★ ★ ★ ★ ★ ★

● *Cotton is scarce. That means fewer buffs for all in these trying times of business change-over and post-war conversion. Yet right at this moment we are working 'round the clock employing all of our skill, men, machines, and limited cotton stocks to keep you so supplied that your plant production and your business will keep functioning as efficiently as possible. Our responsibility is to see that you get enough buffs to give you an equitable share of today's business. We are doing all within our power to see this responsibility through. There are no shut downs for American Buff Company customers.*

Please be assured that as promptly as we receive larger quantities of standard buff sheetings you will receive the famous American Made Amflow and Shurflow Bias Buffs, as well as the other standard American Made full disc and pieced buffs and polishing wheels. The American Family of Buff Makers thank you for your splendid spirit of co-operation in accepting the substitutes that we have been able to offer. Keep calling on us and we will try to help you. Our telephone numbers begin with

FRANKLIN 4137.

AMERICAN
BUFF COMPANY

CHICAGO 6, ILL. • SALES OFFICES IN PRINCIPAL CITIES

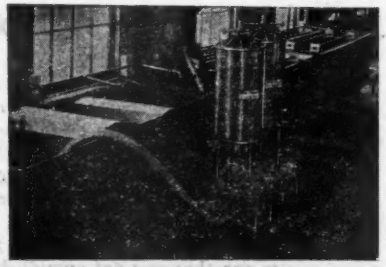
ALSOP "Sealed-Disc" FILTERS

for your electroplating work

These typical applications may suggest where you, too, can use the "*Sealed-Disc*" filter for the same positive, trouble-free plating.

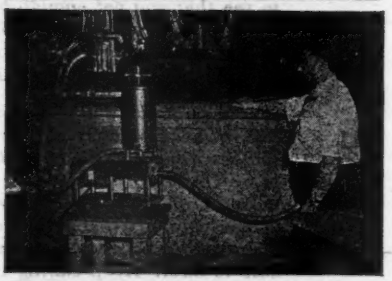
A Leading Silversmith

Uses this 3000 gals. per hour capacity filter for continuously filtering large tanks and for quick filtering on a number of small tanks. Note how pump and motor are completely enclosed to prevent acid from spilling on machine. Here the sealed feature, eliminating loss through leakage or dripping is a deciding factor.



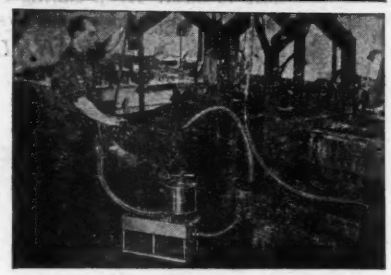
A Hardware Manufacturer

Efficiently keeps an automatic plating tank clean with this 600 gals. per hour filter. Several of these filters can be used on different stages or solutions including the cleaner for certain types of work. This filter is complete as shown, no extra equipment such as mixing tanks are required because no filter aids are necessary.



A Manufacturer of Electrical Devices

Here a 300 gals. per hour filter complete with electric pump requires only 9" x 20" of floor space. It is especially adaptable for keeping solutions clear in this barrel plating process. The exceptionally small space requirement coupled with the amazingly high capacity and filtering speed is a distinct advantage in producing more perfectly finished work in less time.



The "Sealed-Disc" Filter

The *"Sealed-Disc"* Filters offer these features and many more. You can have the same positive, trouble-free plating. Just write us for details; there's no obligation.

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ENGINEERING CORPORATION

Filters · Filter Discs & Sheets · Mixers · Agitators

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CHROMIUM CHEMICALS

FOR THE ELECTROPLATER

- **BICHROMATE OF POTASH**
- **BICHROMATE OF SODA**
- **CHROMIC ACID**

MUTUAL CHEMICAL COMPANY OF AMERICA

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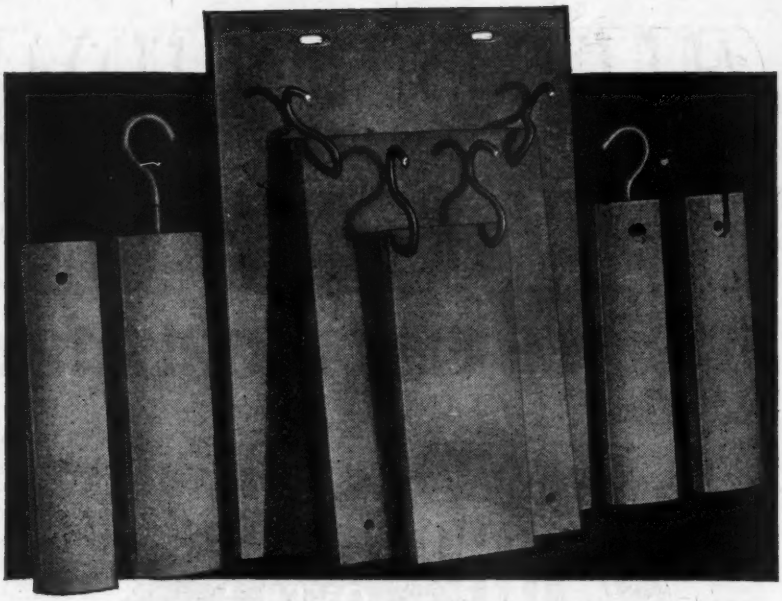

Enjoy all these advantages with *Anaconda Copper Anodes*

Anaconda Copper Anodes—whether Sheet, Oval, or Electro-deposited —contain less than 0.01 percent of total metallic impurities. This unexcelled high degree of purity pays you with the following advantages:

1 Copper goes into solution faster and more uniformly.
2 The highest quality deposit is produced in the shortest possible time.
3 Slime is reduced to an absolute minimum.
4 Spotting and discoloration of the deposit are eliminated.
5 Scrap losses are exceptionally low.

American Brass produces a complete line of Copper, Brass, and Bronze Anodes . . . rolled Sheet or Oval . . . cut to your own specifications or standard sizes . . . drilled or undrilled . . . with or without hooks—also Electro-deposited Anodes. For present or future reference, write for Publication C-5.

ANACONDA

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Conn. • *Subsidiary of Anaconda Copper Mining Company.* In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

4 EXTRA VALUES BEHIND AHCO PRODUCTS

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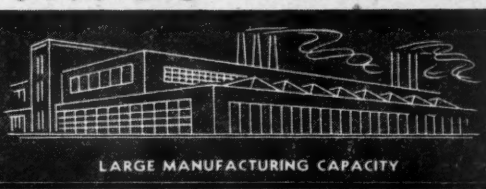
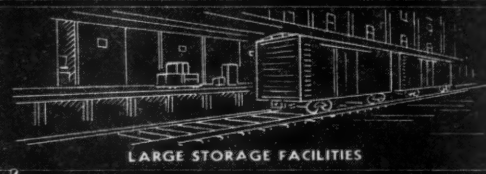
BUFFING COMPOSITIONS
METAL CLEANERS

1. 96 years of experience and research is represented in the manufacture of these quality products. Production facilities occupy several thousand square feet in modern buildings.



LARGE MANUFACTURING CAPACITY

2. The large storage facilities, the economical means of purchasing and handling carload quantities keep prices at lowest leve' . . 'l plating and finishing supplies available from one source.



LARGE STORAGE FACILITIES

3. We maintain a well equipped chemical laboratory manned by competent chemists. The services of this laboratory are available for analytical and consulting work on specialized problems.

MODERN CHEMICAL LABORATORIES

4. Distributors for AHCO products are located in principal cities throughout the United States to facilitate nation-wide distribution. Shipments are made 24 hours after order is received.

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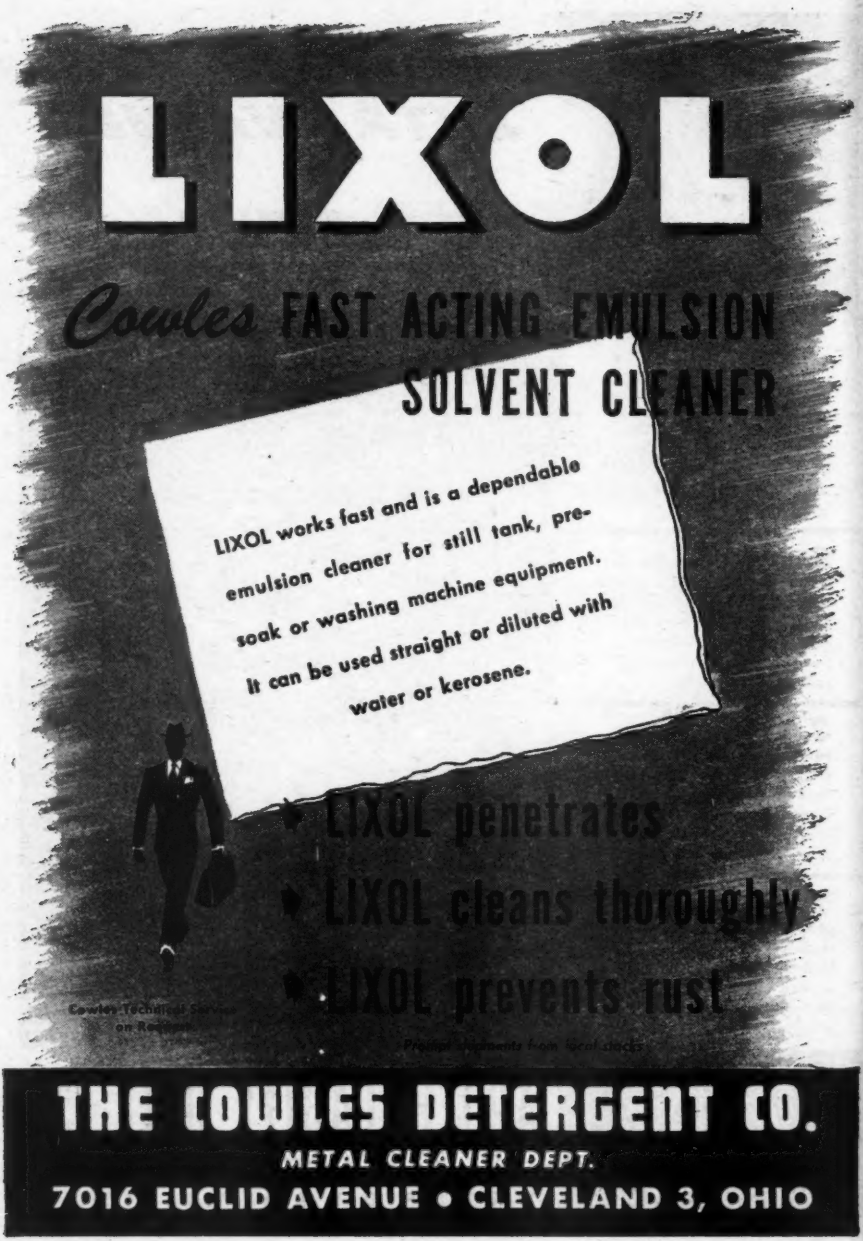
LIXOL
Cowles FAST ACTING EMULSION
SOLVENT CLEANER
LIXOL works fast and is a dependable emulsion cleaner for still tank, pre-soak or washing machine equipment. It can be used straight or diluted with water or kerosene.
• LIXOL penetrates
• LIXOL cleans thoroughly
• LIXOL prevents rust
THE COWLES DETERGENT CO.
METAL CLEANER DEPT.
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PARTLY CLEAN ISN'T ENOUGH

. . . Do the Whole Job and Do It Right

In cleaning an electroplating solution, as in cleaning a house, part-way measures aren't enough. Your metal may be clean to begin with, for instance, but unless the plating bath is also kept clean, pitting, spotting and poor adhesion are likely to follow.

DARCO S-51, when used correctly, assures continuous purification of the bath by adsorption of the contaminants that often cause trouble. It permanently removes grease, oil, soap, colloids and other decomposition products — yet does not alter the chemical composition of the solution itself.

DARCO S-51 is used successfully in improving the electroplating quality of a wide range of metals — bright nickel, cyanide zinc, cadmium, copper, iron, gold and silver. It saves time, labor and metal — and a few cents' worth purifies 100 gallons of solution for a week.

Get acquainted with DARCO S-51. If you have a special purification problem, we'll be glad to help you solve it.

(This trademark identifies the genuine. Accept no packages without it.)

DARCO

DARCO CORPORATION

60 E. 42nd Street, New York 17, N. Y.

DARCO—REG. U. S. PAT. OFF.

Is Your Plating Bath as Clean as the Water Used in Your Final Rinse?

DIVERSEY PRODUCTS FOR THE ELECTROPLATER

No. 12—The anodic cleaner for steel. Removes tenacious deposits prior to bright plating. Minimizes foam blanket.

No. 22—A vigorous heavy duty product for soak tank and barrel type cleaning. Rapidly wets and emulsifies dirt, grease and oil. Free rinsing.

No. 44—A medium duty cleaner particularly designed for soak cleaning of brass and zinc base die casting. Effective as a barrel cleaner prior to burnishing.

No. 16—An emulsifiable solvent that loosens and dissolves buffing and polishing compounds. Also effective as an emulsion cleaner for pre-soaking operations. Has quality rust inhibiting properties.

Everite — An inhibited acidic product for removal of heat scale and rust. Negligible attack on base metal with greatly reduced tendency for hydrogen embrittlement.

Just suppose you've given a Diversey D-Man a trial order. Usually on the very day that Diversey drum or barrel rolls into your plant, you'll find the Diversey D-Man on the job, decked in overalls with shirt sleeves rolled up.

Your D-Man is not merely an order-taker. The most important part of his job is to make certain that your plant men use that Diversey product properly and to best advantage.

Service That Delivers Results

Sure it costs money to put a D-Man in your plant for a couple of hours or days just to service a drum of material . . . but it pays in the long run for you as well as us. The Diversey D-Man delivers *results* . . . not merely so many pounds of material. That's why more and more plants everywhere are looking to Diversey for *all* their metal preparation requirements.

Metal Industries Department

THE DIVERSEY CORPORATION
53 W. Jackson Blvd., Chicago 4, Ill.

Flexible power FOR PLATING CHANGE-OVER!

QUICK CHANGE OF CIRCUIT CONNECTIONS PERMITS CHOICE OF OUTPUT TO MEET VARYING PLATING, ANODIZING NEEDS— CUTS INVESTMENT IN POWER SUPPLY.

General Electric copper-oxide rectifiers for plating and anodizing are widely used in multiple-unit arrangements that offer "building block" flexibility. Essentially a step-down transformer and a rectifier, each G-E self-contained unit provides smooth, steady direct current in blocks of 6 or 12 volts.

Output voltage of a single unit, or of a multiple-unit group, is accurately controlled on the a-c input side by G-E rectifier control. By substituting this "on load" control for tank rheostats, important power savings are realized. Control can be automatic or manual. With G-E automatic control, voltage is maintained within plus or minus two per cent, from no load to full load.

There are many G-E plating and anodizing rectifier and control combinations of different ratings built to meet your exacting needs. For illustrated booklet and full information, write General Electric Company, Appliance and Merchandise Department, Section A561-106 Bridgeport, Connecticut.

GENERAL ELECTRIC

It's New! It's Different! It's KWIK-SEAL by Du-Lite!

Kwik-Seal, an entirely new type oil just perfected by Du-Lite, has important advantages where oil treated parts, either chemically finished or not, must be assembled for fast production. It's a finishing oil with these desirable qualities:

1. **Dries dust-free in a few minutes, and thereby hastens production.**
2. **Leaves no sticky residue or gummy deposits; easy to handle by assembly operators.**
3. **Gives superior protection because of its excellent rust retarding properties.**

Assemblers of "Kwik-Seal treated parts" find them clean and fast to handle.

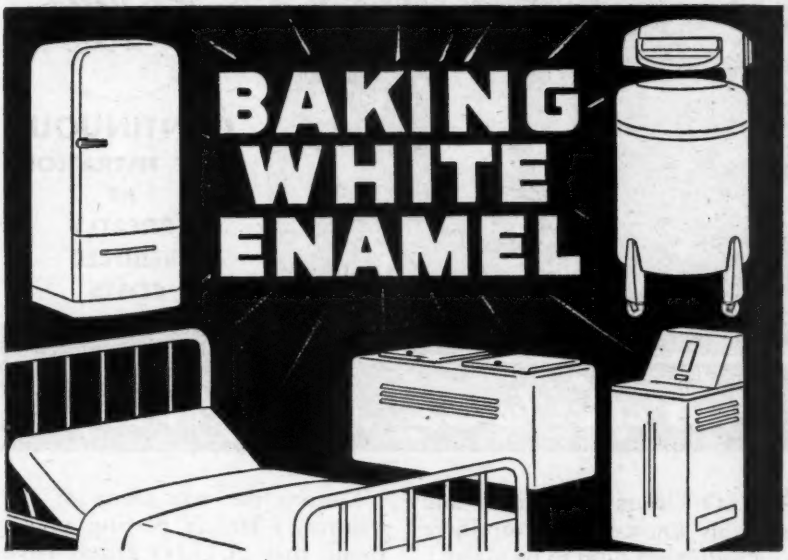
You can have absolute confidence in Kwik-Seal, for it is backed by the makers of Du-Lite, the dependable black oxide finish for steel.

Write to Du-Lite at Middletown for further information. A representative will be glad to discuss your finishing problems with you.

DU-LITE CHEMICAL CORP.

Dept. B, Middletown, Connecticut

Here is Egyptian's new Baking White Enamel



Resistant to:

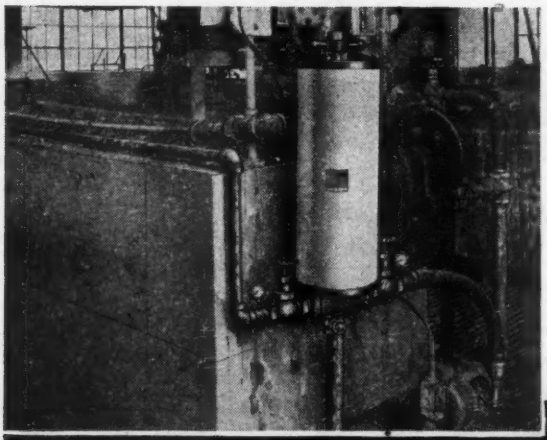
ABRASIVES · ACIDS
ALKALIS · SALT SPRAY · HUMIDITY
WATER IMMERSION and
SOFTENING ACTION of FATS and OILS

Spray it on clean bare metal. Needs no primer. Bakes fast to a hard, glossy finish.

Put Your White Finish Problems Up to Us

THE EGYPTIAN LACQUER MANUFACTURING COMPANY
ROCKEFELLER CENTER, NEW YORK 20, N. Y.

EGYPTIAN
SPECIALIZED PRODUCTION FINISHES



Fulflo FILTERS

CONTINUOUS FINE FILTRATION AT GREATLY REDUCED COSTS

Hour after hour . . . day after day!

FULFLO Filters are widely and favorably known wherever there is an industrial fluid to be filtered.

Their genuine Honeycomb Filter Tubes give true depth filtration, remove all suspended impurities down to microscopic size. Cannot rupture, channel or bypass. They will handle extremely large volumes of liquids with very low pressure drop, for long periods of time before replacement is necessary.

Honeycomb Tubes can be replaced quickly with no fuss, muss or bother and at nominal cost . . . without shut-down and without loss of fluid. No added chemicals or "filter-aids." No screens to bend. No plates or "cakes" to break. No attention required between tube replacements.

During the war many of the country's largest plating plants found that FULFLO Filters gave them finer and faster plating with fewer rejects. And filtration costs fell to a fraction of former levels.

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Change of . . .

PUBLICATION and DEADLINE DATES

FOR

MONTHLY REVIEW

Effective with the July issue, MONTHLY REVIEW will be mailed on the 1st of each month.

To accomplish this, it is necessary to establish an earlier deadline for the receipt of manuscripts, advertising, and Branch Secretaries' reports. At the present time the deadline is the 25th of the month preceding publication.

To start and keep MONTHLY REVIEW on its new schedule the following new deadline dates must be observed:

Manuscripts and reports from Branch Secretaries— 5th of month preceding publication.

Advertising — 12th of month preceding publication.

The deadlines for the July issue thus become the 5th and 12th of June for editorial and advertising matters respectively.

Because the benefits and advantages are mutual the Editor solicits the cooperation of all concerned.

—: PROG

Thirty-third Ann

AMERICAN ELECTRO

JUNE 16-20, 1946 at the WILLIA

MEN'S PROGRAM

Sunday, June 16

3:00 P.M. — REGISTRATION, 17 Floor (Express Elevator from Main Lobby). Registration Fee for all functions: $5.00.

Monday, June 17

8:00 A.M. — REGISTRATION, continued throughout the Convention.

10:15 A.M.—OPENING SESSION, Urban Room, 17th Floor.

Invocation — The Rev. Frank C. Mesle
Welcome — Mayor David L. Lawrence
Formal Opening — S. S. Johnston, General Chairman
Greetings — Frank R. Keller, President, Pittsburgh Branch
The President's Report—Walter L. Pinner, President A.E.S.
Business
Adjournment at 12:00 Noon.

12:00 Noon — INTERNATIONAL FELLOWSHIP CLUB'S ANNUAL LUNCHEON (I.F.C. Members only), Cardinal Room, 17th Floor
Fellowship Affairs
Election of Officers.

2:00 P.M. — FIRST EDUCATIONAL SESSION, Urban Room, 17th Floor — W. M. Phillips, Chairman

1. *Wartime Plating Developments in England* — A. W. Hothersall, Woolwich Arsenal, England
2. *Summary of War Time Research on Plating at the National Bureau of Standards* — W. Blum, National Bureau of Standards
3. *Deposition of Nickel by Chemical Reduction* — Abner Brenner and Grace E. Riddell, National Bureau of Standards
4. *Purification of Rhodium Plating Solutions* — Abner Brenner and Walter A. Olson, National Bureau of Standards
5. *X-Ray Diffraction Studies of Electrodeposits* — Theodore Voyda, Pratt & Whitney Aircraft
6. *Electropolishing — What is its Status Today?* — Charles L. Faust, Battelle Memorial Institute.

9:00 P.M. — OPEN HOUSE through the courtesy of the International Fellowship Club
Music — Dancing — Refreshments — Special Awards.

Tuesday, June 18

9:00 A.M. — SECOND EDUCATIONAL SESSION, Urban Room, 17th Floor — E. S. Taylerson, Chairman

1. *Corronizing Wire Screen Cloth Using Radiant Heating* — J. Edward Bemiller, Hanover Wire Cloth Co.; Damon C. Antel, Standard Steel Spring Company
2. *Some Observations on Alkaline Electrotinning* — T. G. Timby, Jones & Laughlin Steel Corporation
3. *Tin Plating of Strip Steel at High Speed* — G. C. Jenison and S. S. Johnston, Weirton Steel Corporation
4. *A Circulating Electrolyte Cell for Strip Plating Evaluation* — R. A. Dimon and

RAMS:—

Annual Convention

PLATERS' SOCIETY

PENN HOTEL, PITTSBURGH, PA.

D. W. Stoner, Carnegie-Illinois Steel Corporation

5. *Disposing of Plating Room Waste Liquors in Compliance with Stream Pollution Laws* — C. J. Lewis, Warner Co.

Afternoon — PLANT VISITATIONS (indicate choice at time of Registration)

Research Laboratories, Aluminum Co. of America, New Kensington, Pa.—Largest laboratory in U. S. for the study of light metals

Jones & Laughlin Steel Corporation, Aliquippa, Pa. — Electrolytic tin strip mill, alkaline type process

Standard Steel Spring Company, Coraopolis, Pa. — Manufacture and plating of automobile bumpers

Weirton Steel Co., Weirton, W. Va.—Electrolytic tin and zinc strip mills, acid tin and zinc processes, bonderizing

6:30 P.M. — JOB PLATERS DINNER MEETING, Cardinal Room, 17th Floor

1. Review of Developments in Job Plating Industry in 1945
2. National Organization of Job Platers.

Wednesday, June 19

9:00 A.M. — THIRD EDUCATIONAL SESSION, Urban Room, 17th Floor — Kenneth Tator, Chairman

1. *The Effect of Surface Preparation on the Durability of Organic Coatings* — V. M. Darsey, Parker Rust Proof Co.
2. *Evaluation of Organic Finishes* — Edward H. Bucy, Zapon Division, Atlas Powder Co.
3. *Natural and Synthetic Rubber in the Electroplating Field* — H. C. Klein, Goodrich Rubber Co.
4. *Resins of the Vinyl Family in Metal Finishing* — F. L. Scott, Organic Division, United Chromium, Inc.
5. *Characteristics of Certain Plastic Films and Coatings* — J. K. Shackleton, Plastics Department, E. I. du Pont de Nemours & Co.

2:00 P.M. — FOURTH EDUCATIONAL SESSION, Urban Room, 17th Floor — Carl E. Heussner, Chairman

1. *Research in Electroplating* — C. E. Heussner, Chairman, Research Committee
2. *Introduction to Reports on Research Projects* — Dr. R. M. Wick, Chairman, Research Directing Sub-Committee
3. *Stripping of Copper From Various Base Metals* — Prof. F. C. Mathers (Indiana University), Project Director, Project No. 1
4. *Determination of Impurities in Electroplating Solutions* — Prof. E. J. Serfass (Lehigh University), Project Director, Project No. 2
5. *Methods for Testing the Adhesion of Electrodeposits* — Prof. A. L. Ferguson (University of Michigan), Project Director, Project No. 3
6. *Effect of Surface Finishing of Non-Ferrous Base Metals on Protective Value of Plated Coatings* — Dr. Wm. Blum (Na-

tional Bureau of Standards), Project Director, Project No. 4

7. *Present Trends in Legislation Affecting Research and Patents* — R. C. Watson, Research Committee Counsel
8. *Effect of Impurities and Purification of Electroplating Solutions* — Prof. D. T. Ewing (Michigan State College), Project Director, Project No. 5
9. *The Nature and Effect of Porosity in Electrodeposits* — Dr. N. Thon (Princeton University) Project Director, Project No. 6
10. *Methods for Testing Thickness of Electrodeposits* — Prof. H. J. Read (Pennsylvania State College), Project Director, Project No. 7
11. *Polarization at Electrodes in Electroplating Processes* — Prof. A. L. Ferguson (University of Michigan), Project Director, Project No. 8
12. *Closing Remarks* — C. E. Heussner, Chairman, Research Committee.

8:00 P.M. INFORMAL GET-TOGETHER, Urban Room, 17th Floor — Come and visit with friends and make new ones.

8:00 P.M. — MEETING OF BRANCH SECRETARIES, Room to be announced.

Thursday, June 20

9:00 A.M. — FIFTH EDUCATIONAL SESSION, Urban Room, 17th Floor — Ellsworth Candee, Chairman

1. *Plating with the Acid Copper Solution* — George Schore, Atlantic Aircraft Supply Co.
2. *A Periodic Chart for Electroplaters* — George Dubpernell, United Chromium, Inc.
3. *Manodizing and Dye Coloring Magnesium Alloys* — Paul R. Cutter, Hanson-Van Winkle-Munning Co.
4. *Practical Facts About Polishing and Buffing Compounds* — Howard J. McAleer, Formax Manufacturing Co.
5. *Parkerizing — Growth or Shrinkage* — N. A. Tope, Humber, Ltd., England.

2:00 P. M. — FINAL BUSINESS SESSION, Urban Room, 17th Floor — President W. L. Pinner presiding

Election of Officers — Selection of 1947 Convention City.

7:00 P.M. — BANQUET, Ball Room, 17th Floor — Banquet — State Show — Dancing — Distribution of Awards.

LADIES' PROGRAM

Headquarters will be maintained on the 17th Floor throughout the Convention. The Local Ladies' Committee will be available to provide information regarding stores, shops and places of interest.

Sunday, June 16

3:00 P.M. — REGISTRATION, 17th Floor (Express Elevator from Main Lobby). Registration Fee for all functions: $5.00.

Monday, June 17

8:00 A.M. — REGISTRATION, continued throughout the Convention.

10:15 A.M. — OPENING SESSION, Urban Room, 17th Floor

Opening Addresses
The President's Report.

1:00 P.M. — LUNCHEON AND ENTERTAINMENT, Gold Room, Roosevelt Hotel, Sixth St. and Penn Ave.

9:00 P.M. — OPEN HOUSE through the courtesy of the International Fellowship Club

Music — Dancing — Refreshments — Special Awards.

Tuesday, June 18

10:45 A.M. — VISIT TO H. J. HEINZ COMPANY Plant with Luncheon (buses at Grant Street Foyer of William Penn Hotel)

VISIT TO BUHL PLANETARIUM.

EVENING — OPEN.

Wednesday, June 19

MORNING — OPEN.

1:00 P.M. — "AUNT ELLA SOCIETY" LUNCHEON AND PARTY, sponsored by Oakite Products, Inc., Gold Room, Fort Pitt Hotel.

8:00 P.M. — BINGO PARTY, sponsored by The International Fellowship Club, Cardinal Room, 17th Floor, William Penn Hotel — Mrs. R. A. Dimon, Chairlady of the Pittsburgh Branch Committee and Mrs. Joan Trumbour Wiarda, Chairlady of the International Fellowship Club, will preside.

Thursday, June 20

11:00 A.M. — BREAKFAST, Cardinal Room, 17th Floor
Your Personality, John Powers School — Souvenirs.

AFTERNOON — OPEN.

7:00 P.M. BANQUET, Ball Room, 17th Floor
Banquet — Stage Show — Dancing — Distribution of Awards.

THE HALL OF PLATERS' CONTRIBUTION TO THE WAR EFFORT

The Adams Room, 17th Floor, William Penn Hotel.

"This Plated Part Helped Win the War" is the slogan for this impressive and interesting Exhibit to which many of the Branches are contributing.

A corps of well informed attendants will be available throughout the Convention.

SAM JOHNSTON—Convention Host

Samuel Stark Johnston is the General Chairman of the Pittsburgh Convention and has the ultimate responsibility for its success and the well being of the members and visitors who attend.

Mr. Johnston is well known in technical circles. Having joined A.E.S. seven years ago, he has for the past two years been President of the Pittsburgh Branch. He is an active member of The Electrochemical Society, American Institute of Chemical Engineers and American Society for Testing Materials.

Before he became engaged in the operating end of strip plating at Weirton Steel Co., Mr. Johnston was active in the development and research that lead to its adoption.

He was born on August 10, 1905 in Steubenville, Ohio, and attended its public schools. Before graduation from High School he worked off and on as laborer in the Mingo Junction Plant of Carnegie Steel Company. He then did routine analytical work in the Chemical Laboratory of the Weirton Steel Company. Enrolled at Ohio State University's College of Engineering in 1924, he graduated in June 1932. By that time, he had earned the nickname "Ohio Forever". During one of the many earning periods which interrupted his studies, he was affiliated with the Metallurgical Advisory Board to the U. S. Bureau of Mines and worked on research problems connected with the open hearth and blast furnaces. After graduation he returned to Weirton.

His outside activities include golf, where he shoots a snappy 120. His men have promised to play with him as soon as he improves further. A sucker for card games, his pet charities are poker, pinochle, bridge and euchre.

Mr. Johnston is assisted by Mr. F. R. Keller, Secretary-Treasurer and Assistant General Chairman, President of the Pittsburgh Branch, and by the following Committees:

Educational Committee

R. A. Dimon, Chairman (Sec'y-Treas., Pittsburgh Branch)

G. A. Jersey (1st Vice President, Pittsburgh Branch)

Dr. L. E. Lancy
D. W. Stoner
M. A. Pederson
K. Tator

Hotel Reservation

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G. C. Jenison
C. C. Cups

Registration

Leo J. Schmitt, Chairman (Member, Board of Managers, Pittsburgh Branch)
L. A. Taylor
G. W. Canaga
R. J. Goldbach
P. Simon
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Entertainment and Banquet

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A. Sabol

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W. S. McKeon, Chairman
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in

PITTSBURGH, PENNA.
June 17, 18, 19 and 20

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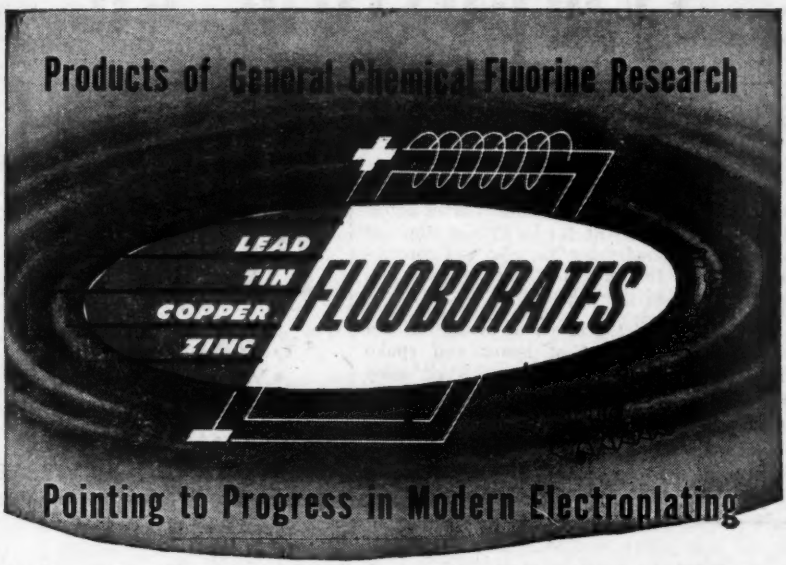

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Zinc Fluoborate • Manual ZF-1 — Metal Fluoborates • Bulletin 1015-A

Symposium on NICKEL PLATING

THIS symposium was held at the Annual Educational Session of the Chicago Branch on January 19, 1946.

The session was opened by the Branch President, C. Kelly. Branch Librarian Carter introduced A.E.S. President W. L. Pinner who not only served as moderator but also had contributed much to the program arrangements and presented one of the papers.

Dr. O. P. Watts, the father of modern nickel plating, was the guest of honor and spoke briefly about his most recent work on alloy plating and "rainbow plating."

The talks and the discussion which follow were wire recorded and transcribed through the courtesy of C. G. Conn, Ltd. and Leonard E. Weeg, its Chief Chemist.

- V. MATTACOTTI
- W. M. PHILLIPS
- B. MARTIN
- M. B. DIGGIN
- W. A. WESLEY
- W. C. PINNER

✦

Cold Nickel Plating and Soft Deposits

By VINCENT MATTACOTTI
Milwaukee Plating Company

Cold Solutions

The use of cold nickel solutions has declined progressively with the introduction of the Watts bath, the bright nickel baths, Wesley's all chloride bath and recently the Pinner modification of the Wesley bath.

Prior to the war, cold nickel solutions were used to some extent on items such as jewelry and picture frames — items that did not require much in the way of thickness of deposit. Cold bright solutions containing gum tragacanths were used for example for flash plating brass articles prior to silver or gold plating.

Cold solutions were also operated in barrels for the plating of small parts which were subsequently to be ball burnished. Where bright deposit had to be produced in the barrel, the introduction into the solution of a brightener such as cadmium, gum arabic or gum tragacanth would suffice. These bright deposits required no burnishing. By present day standards they had inferior properties: they were brittle, their thickness was of a low order and, in general, it was quite difficult to chromium plate over them.

Among the cold solutions are the so-called die cast or high sulphate bath, typical of which is the Thompson solution for plating on zinc and zinc alloys. The Thompson formula calls for 9 oz/gal. nickel sulphate, ⅔ oz/gal. ammonium chloride, 2 oz/gal. boric acid and 20-30 oz/gal. sodium sulphate decahydrate. The large quantity of sodium sulphate permits deposition of nickel on zinc or zinc die castings without the formation of streaks in low current density areas. The deposit tends to be brittle and sometimes a more ductile

nickel coating is deposited over the flash nickel. The use of preliminary copper coatings on die castings has to great extent made the Thompson die cast nickel bath obsolete.

Cold nickel baths are ordinarily operated at temperatures ranging from 60 to 90°F, a pH of 5.2 to 6.0 colorimetric, current densities not exceeding 20 amp/sq.ft. and, in general, more nearly 3 to 5 amp/sq. ft. Agitation is not employed and filtration and purification treatments are practically non-existent. However, the operation is relatively trouble free and a rather good, semi-hard deposit of a low order of thickness is obtained; 0.0002-0.0003 in. is about the maximum thickness. To produce a thickness of 0.001 in. such as is commonly required today, would require plating at 3 to 5 amp/sq.ft. for 3 to 4 hours.

Another cold nickel solution, the so-called double nickel salt bath, contained 14 oz/gal. nickel ammonium sulphate, 2 oz/gal. ammonium chloride, 2 oz/gal. boric acid and was operated at a pH of 5.8. This bath produced at a slow rate a very fine-grained deposit which was readily buffed.

Soft Deposits

In discussing the hardness characteristics of electrodeposited nickel, it is well to keep in mind what Hothersall and Macnaughtan have pointed out — namely that nickel which is metallurgically hard as a rule can be buffed much more readily than nickel which is metallurgically soft.

Waite confirmed this in a paper presented some years ago. He noted that an increase in the chloride content of a nickel solution increased the hardness of the deposit and made buffing easier. The effect is more pronounced at a high temperature of 140°F and a nickel concentration of over 20 oz/gal.

Pinner and Kinnaman in March 1945 discussed the development of high speed, dull and semi-bright solutions derived from Wesley's all chloride bath. One of the conclusions drawn by the authors was that the nickel was readily buffed.

Wesley has noted the conditions required for producing soft and hard nickel as follows: The soft nickel is produced from a Watts type bath containing per gallon nickel sulphate 44 oz., boric acid 4 oz. and nickel chloride 4 oz. It is operated at 140° F, a pH of 2.0 electrometric and a current density varying from 25 to 100 amp/sq.ft. depending on whether agitation is used or not. Such a bath produces nickel of 140-160 Vickers hardness. For the production of hard deposits, Wesley suggested a bath consisting of 16 oz/gal. nickel sulphate, 2.3 oz/gal. ammonium chloride, 1.1 oz/gal. potassium chloride, operated at 120-130°F and a pH of 5.2 to 5.8. This bath gives deposits with the hardness ranging from 350 to 400 Vickers as compared to 140-160.

Macnaughtan and Hothersall showed that the presence of ammonium sulphate in the nickel solution permitted the formation of deposits of much higher hardness than with other addition agents.

Summing up the conditions for obtaining easily buffed nickel, one method would be to use Wesley's all chloride bath. Deposits from this bath are harder, stronger and less ductile than deposits from the sulphate or Watts bath. Waite, Long, Casper, Pinner and Borchert have reported that adoption of these deposits leads to a decrease in buffing costs. Wesley shows that the white matte and semi-bright deposits that can be obtained from these baths polish readily. The semi-bright coating was brought to a mirror-like finish with only slight buffing on a soft rag wheel with rouge without the use of cutting compounds. The second method would be the use of the Pinner solution. The third method would be to use one of the semi-bright nickel solutions which are purposely compounded for producing nickel which can be readily buffed.

Maximum softness, metallurgically speaking, is required when the deposited nickel is to be subsequently formed. The following conditions produce a nickel plate, the Vicker hardness of which is less than 200: a Watts bath operated at 140°F and a pH below 4.0, with complete absence of ammonium, sodium and potassium salts, low concentration of iron, freedom from inorganic impurities such as small quantities of cadmium or copper and organic impurities such as gums, low chloride concentration sufficient only to permit satisfactory anode corrosion, and absence of suspended matter brought about by continuous filtration. As long as filtration is necessary one might just as well use activated materials in the filter to keep organic matter under control.

Watts Type Nickel Baths

By W. M. PHILLIPS

General Motors Corporation

In his famous paper of 1916 Watts mentioned the fact that prior to his development, nickel was usually plated at current densities not exceeding 4 or 5 amp/sq.ft. That statement is perfectly true. Very often plating was done at 2 or 3 amp/sq.ft. The Watts bath was and is a very useful contribution in the progress of nickel plating. From the Watts bath there was produced enough nickel plate to be the equivalent of a path of nickel 3 ft. wide and .0003 in. thick, long enough to reach from the earth to the moon and back again. Since this distance is about 268,000 miles, it represents a great deal of nickel.

Table I shows the formula for the Watts nickel bath, as we all understood and used it.

TABLE I

ORIGINAL FORMULA FOR WATTS NICKEL BATH

(Metal Industry 1916)

	g/l	oz/gal
$NiSO_4.7H_2O$	240	32
$NiCl_2.6H_2O$	20	3
H_3BO_3	20	3

One of the developments which we have had to do with was a low pH nickel bath using the same formula. Figs. 1 to 4 demonstrate how the plating range was increased by departing from the old ideas of high pH baths. They are taken from a paper given in 1930, fourteen years after the Watts nickel bath was developed.

Fig. 1 shows the effect of variation of the pH from 6 to 1. We were able to get a very useful deposit at 150 amp/sq.ft.

Fig. 2 shows something very interesting, that bright nickel can be produced from a Watts bath without any addition agent whatever. I have such panels that were made in 15 seconds. The plate has a great many advantages. One of them is that there are no pits because the nickel is not thick enough to pit. Another is that the operation is very cheap. Probably most important is that one does not need to worry about the quality of this plate. One can be sure that it will fail.

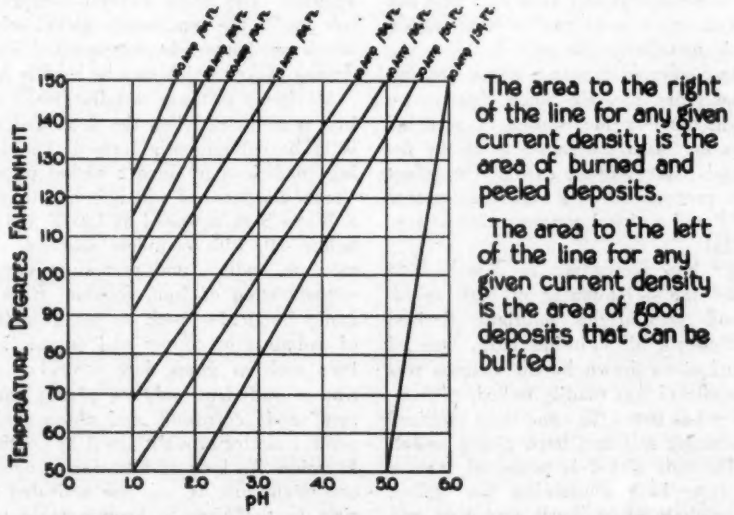

Fig. 1. Effect of pH and temperature on maximum current density for five-minute nickel plates.

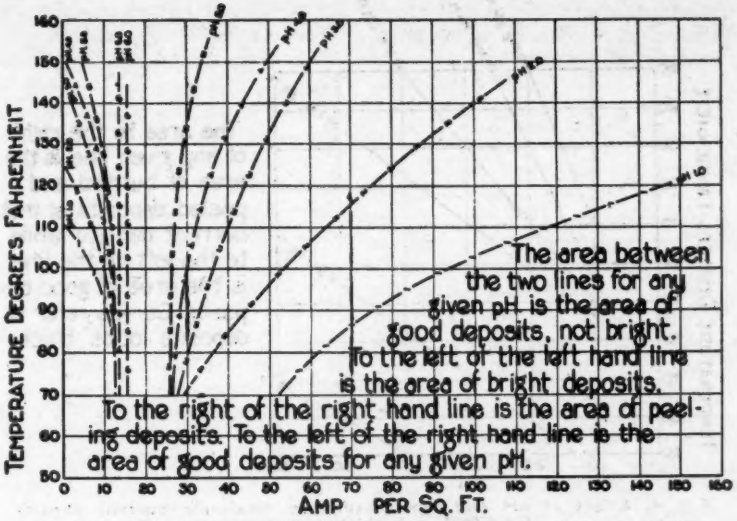
TEMPERATURE DEGREES FAHRENHEIT
AMP PER SQ. FT.
The area between the two lines for any given pH is the area of good deposits, not bright. To the left of the left hand line is the area of bright deposits.
To the right of the right hand line is the area of peeling deposits. To the left of the right hand line is the area of good deposits for any given pH.

Fig 2. Effect of current density, temperature and pH on character of five-minute nickel plates.

Fig. 3 was obtained with plates of a thickness which is used a great deal in specification plating, namely 0.0005 inch. It is evident that good physical characteristics can be obtained when the relation between temperature and current density is controlled in a properly constituted bath. Note that very good plate was had at 160 amp/sq.ft. when the bath temperature was at least 150°F and the pH 1 or less.

Fig. 4 demonstrates very much the same thing except it is a different presentation of another half thousandths set-up. We have stopped in this case at 100 amp/sq.ft.

Our work with the Watts bath was to control the acidity at lower pH ranges than had hitherto been thought possible. The discovery was somewhat of an accident.

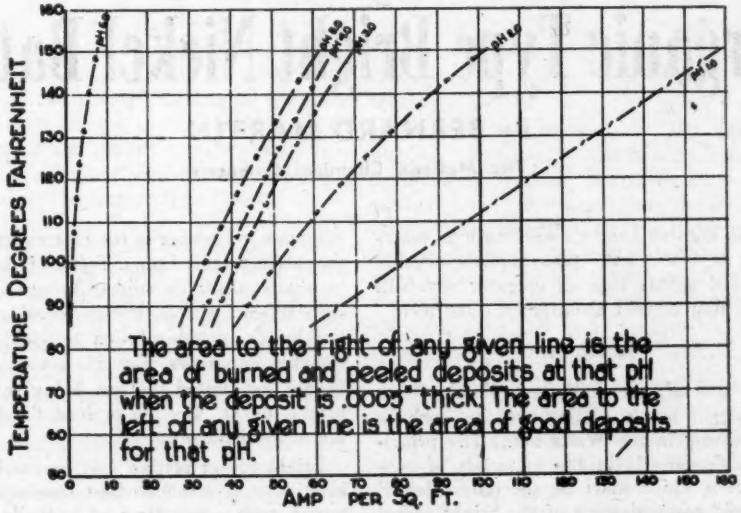
TEMPERATURE DEGREES FAHRENHEIT
AMP PER SQ. FT.
The area to the right of any given line is the area of burned and peeled deposits at that pH when the deposit is .0005" thick. The area to the left of any given line is the area of good deposits for that pH.

Fig. 3. Effect of temperature, current density and pH on characteristics of 0.0005 inch thick nickel plates.

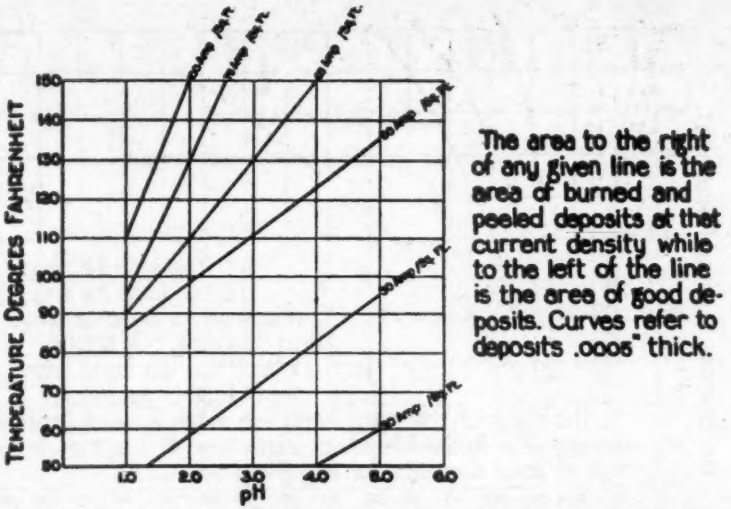

Fig. 4. Effect of pH and temperature on maximum current density for 0.0005 inch thick nickel plates.

One of our Divisions was using colorimeteric equipment to determine the acidity of its nickel baths. The operator did not know how to use it and missed the proper indication by making readings at a secondary color change. This particular Division was able to dissolve the anodes most satisfactorily and produced better nickel plating at higher current densities than other Divisions. We made a proper determination of the pH and, to our surprise, discovered it to be 2.5. Laboratory work then showed that the low pH was responsible for the solubility of the nickel anodes and the more successful operation of the bath in definite ranges of temperature and current density.

Organic Type Bright Nickel Baths

By BERNARD MARTIN

The McGean Chemical Company

The organic bright nickel bath is essentially a Watts bath plus suitable organic addition agents plus an operator who will mind that certain requirements are met.

Equipment

In general, the equipment requirements for bright nickel plating are the same as for plating in the Watts bath. The principal difference is in the materials of construction which must be specially selected to avoid contamination of the bright nickel bath. Experience has shown that properly compounded rubber is the best material for the plating tank lining. Some of the commercially available rubber linings are unsatisfactory because they are acted upon by the bright nickel solution to yield objectionable impurities. For this reason rubber should be tested before being used in bright nickel. Wooden or lead lined tanks are not satisfactory.

Bright nickel plating may be carried out in still tanks although best results are obtained with some form of cathode agitation. Movement of the cathodes in full and

semi-automatic equipment or by use of reciprocating cathode rod in non-automatic equipment provides sufficient agitation.

The bright nickel solution may be heated by circulation through an external heat exchanger or by means of coils placed in the plating tank. The heat exchanger is usually employed in large installations. Duriron, carbon or glass are suitable materials. Lead may be used if the nickel chloride concentration does not exceed 8 oz/gal. The circulating pump may be duriron or rubber covered steel; again lead can be used only with low chloride solutions.

In most instances a filter is arranged in series with the heat exchanger. In this way, suspended particles of dirt, etc. are continuously removed from the solution as it is being heated. The solution should be returned to the plating tank at a point below the bath level to prevent formation of foam. If the plating tank is long, the solution should be returned at several points. A by-pass around the filter will provide for cleaning of the filter without interruption of the plating operation. Cylindrical tank type filters are satisfactory provided surfaces in contact with the bright nickel solution are non-contaminating. Stainless steel or monel have been suggested for this service, but experience has shown that both are objectionable.

Control instruments on the plating tank should include an ammeter and a temperature indicator. In addition, ampere-hour meters help in determining the time for making brightener additions. The consumption of addition agents is roughly proportional to the number of ampere-hours passing through the plating solution and once relation has been established, additions can be timed by the ampere-hour meter.

Occasional purification of the bright nickel tank is required. Equipment for this operation include a tank, pump and filter. The tank should have a capacity approximately 25% greater than the volume of bright nickel plating solution to be treated and should be provided with some form of agitation. The requirements for the pump and filter are as described above except that the holding capacity of the filter for purification services should be greater.

Plating racks for use in bright nickel plating should be coated with a material of an approved type to avoid contamination of the solution. Good rack construction and maintenance is likewise important to provide favorable drainage characteristics and plate distribution.

Quality of Deposit

A bright nickel deposit tends to be smoother than the surface on which it is placed, the effect becoming more pronounced as the thickness of coating is increased. However, pronounced irregularities in the subsurface are not covered up by thicknesses ordinarily employed and should be eliminated before the bright nickel plating. Die castings are color buffed and given an undercoat of electrodeposited copper. The copper must be uniformly fine grained if the bright nickel plated castings are to go directly into chromium. Brass parts are finished by buffing. The treatment of steel parts will depend upon the relative cost of polishing the steel and buffing of the electrodeposited metal. If the cost of acquiring a satisfactory finish on steel is excessive, the parts may be copper plated and copper buffed to obtain the desired finish. To procure full luster, thorough cleaning of the work is required prior to bright nickel plating. The bright nickel surface magnifies irregularities in cleaning which would pass unnoticed in dull nickel deposits. The choice of cleaner depends upon the metal to be cleaned and the type of surface contaminant to be removed. Particular attention should be paid to the cleaning of recessed areas. Satisfactory cleaners are available for use on all common base metals.

The selection and care of acid dips is likewise important in the preparation for bright nickel plating. Muriatic acid is usually employed for this purpose, the concentration being governed by the metal to be processed. The surface of the dip should be kept clean at all times and the acid strength maintained. Efficient rinsing is essential both before and after the acid treatment.

The degree and type of brightness obtained depends upon the particular organic brighteners employed. A wetting agent is usually added to eliminate pitting. Hydrogen peroxide cannot be used in the organic bright nickel bath because of its adverse affect on the organic brighteners.

Bath Operation

The bright baths operate over a comparatively wide range of conditions. pH values range from as low as 2.0 up to 4.0 and higher. The temperature is also not very critical. The cathode current density range is broad. The optimum value for operating conditions in a given bath will depend upon several factors, however, including the type of work being plated, agitation, rate of cathode movement and rate of deposition. Once established, these values should be maintained within narrow limits. High purity nickel anodes should be used and the anodes bagged to prevent anode sludge from getting in the bath.

All constituents of the bath will require replenishing from time to time. The better practice is to make frequent small additions of brighteners rather than occasional large ones. Brighteners are added on the basis of the amount of work put through the tank. In addition, their concentrations are determined periodically by analyses. Additions of anti-pitting agents are usually governed by the appearance of the deposit with an occasional analysis to make certain that the concentration does not exceed the recommended limits.

Every effort should be made to prevent the contamination of the bath with impurities, both organic and inorganic. Organic impurities may be extracted from anode bags, from bags used in making chemical additions, from filter cloth, from rack coatings and from tank linings. Other sources of organic contaminants include air born dust, lubricant from conveyors and improperly rinsed work. Inorganic impurities which may cause trouble, if present in sufficient amounts, include chromic acid, copper, lead, tin, iron, aluminum, alkali and ammonium salts. Allowable limits for these impurities vary with different processes and operating conditions.

Means for purification of bright nickel baths are available and contaminated baths can be cleaned readily. Organic impurities usually yield to treatment with activated carbon while most inorganic impurities can be precipitated at a high pH and removed by filtration. Chromic acid must be reduced to a trivalent state before the high pH treatment, while ferrous iron should be oxidized prior to treatment. Copper is removed by deposition at low current densities. Alkali and ammonium salts cannot be removed economically.

Bright nickel is harder, finer grained and somewhat less ductile than dull nickel from the standard Watts bath. The protective value, however, as determined by outdoor exposure tests, is at least equal to that of dull nickel.

Alloy Type Nickel Baths

By M. B. DIGGIN

Hanson-Van Winkle-Munning Company

The average electroplater knows from experience that the physical characteristics of electrodeposits can be varied within wide limits by changing solution composition, temperature, current density, degree of agitation, and by the use of addition agents. Much greater variations in chemical and physical properties result from the codeposition of metals in alloy plating.

A wide variety of metals and metalloids have been codeposited with nickel, such as cobalt, iron, copper, lead, zinc, cadmium, chromium, silver, gold, manganese, molybdenum, sulfur, selenium, tellurium, tin, tantalum and tungsten. Various ternary nickel alloys have been investigated, as for example the nickel-iron cobalt and copper-nickel-iron systems.

Because of the limited time, we shall not elaborate on the processes which are not used commercially to any substantial extent, rather we shall concentrate on the cobalt-nickel alloy process based on the Weisberg-Stoddard patents. It is safe to state that, within the past ten years, more alloy plating has been conducted in this bath than in all other alloy solutions combined. It represents a considerable proportion of the bright nickel plating which has been performed since the inauguration of modern bright nickel solutions.

Bath Constituents

Table I indicates the type of solutions employed, essentially a Watts solution with certain additions. It contains nickel sulphate and nickel chloride — the first salt to furnish the principal source of metal and the other for anode corrosion. Boric acid is included, not to act as the buffer in this case, but for its favorable effect in minimizing burning on high current density areas. The small amount of ammonium sulphate present has a pronounced effect upon the brightness of the deposits. Formaldehyde is added in trifling quantities as a cathode depolarizer, functioning as an anti-pit. Its presence eliminates the disadvantage of having to use a wetting agent in the bath. Nickel formate is the excellent buffer in the pH range within which these solutions are operated.

TABLE I

COMPOSITION OF COBALT-NICKEL BATHS

Constituents	Type 9H Concentration,	Type 5 oz/gal	Type AA
Nickel sulphate	32.0	32.0	32.0
Nickel chloride	4.0	4.0	4.0
Cobalt sulphate	0.35	0.6	2.0
Boric acid	4.0	4.0	4.0
Ammonium sulphate	0.10	0.10	0.10
Formaldehyde	0.33	0.33	0.33
Nickel formate	6.0	6.0	6.0
	pH	electrometric*	
For maximum brightness and throwing power	3.7	3.7	3.7
For semi-bright deposits of maximum softness and ductility	2.3	—	—

*Colorimetric values about 0.5 units higher.

Incidentally, in the formula shown, there are no brighteners indicated. Organic compounds of high molecular weight are not required for brightening action. Deposit brightness depends upon maintaining the optimum concentration of salts — especially cobalt sulphate — and optimum operating conditions.

Bath Operation

The pH of the cobalt-nickel baths is varied to produce the desired plate characteristics. For brightest deposits and highest throwing power, the solution is operated in a pH range of from 3.5 to 3.7 electrometric. The softest and most easily buffed deposits are produced at a pH of 2.0 to 2.7 electrometric. The adjustment of pH can be made with formic acid which tends to maintain the required formate buffer concentration.

Most commercial installations operate within a current density range of from 40 to 60 amp/sq.ft., although the range may be from 7 to 100 amp/sq.ft. The voltage required is between 3 to 4 volts at 40 to 60 amp/sq.ft.

The optimum bath temperature is between 140-160°F. Heating is accomplished by means of external heat exchangers.

The solution is agitated because of the favorable effect upon the brightness of deposits. Air agitation is most common, but mechanical agitation can be employed.

Since agitation is used, continuous filtration is recommended. The rate should be such that the solution is turned over about once every two to three hours.

As this is a heated solution, operating at 160°F, a small amount of formaldehyde permeates the atmosphere. Hence it is advisable to use tank ventilation.

Special cobalt-nickel anodes are used. In the original process, the anodes contained 18% cobalt, but to reduce costs and as experience was gained in controlling brightness, the cobalt concentration was reduced for many purposes, first to 5% and then to 1%. With alloy anodes, the ratio of cobalt to nickel in the bath comes to a stable equilibrium after a short period of use.

The preparation of surfaces for cobalt-nickel plating is essentially the same as for ordinary plating. Thorough cleaning, with care to prevent cleaners containing wetting agents from drying on the work, ample pickling and good rinsing are prerequisites which insure adherent and uniformly bright deposits.

Many of the early troubles experienced with bright nickel solutions, including cobalt-nickel solutions, were caused by improper installation. By use of continuous filtration, careful selection of engineering

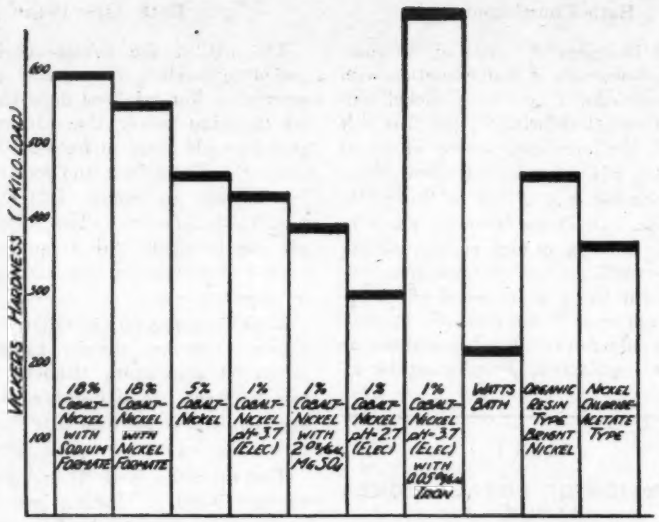

Fig. 1. Hardness of cobalt-nickel and other nickel deposits.

materials in contact with the plating solution and institution of control measures to keep the solution pure, all of these difficulties were soon eliminated.

As mentioned previously, the cobalt-nickel solutions do not contain brighteners or organic compounds of high molecular weight, therefore no troubles are experienced with breakdown products. For example, should nickel formate and formaldehyde decompose, only carbon dioxide and water could be formed. These end products would not be particularly harmful.

A unique feature of cobalt-nickel solutions is that they can be analyzed by simple volumetric methods. It is not necessary to use indirect methods and, therefore, one can be certain that the solution is in balance at all times. The solution, in addition to this feature, has a wide permissible range of concentrations, i.e. it can be diluted or one of the constituents can be abnormal in concentration without serious results. In the Connecticut River Valley some years ago, a cobalt-nickel solution was in operation until the flood waters covered the tank. When the flood had subsided, the plater looked in the tank and seeing a green color, simply corrected the pH and started plating successfully, although he did have to operate at lower current densities. It was estimated that about three-quarters of the solution had been lost.

Plate Characteristics

We shall now discuss the characteristics of deposits produced in these solutions. In the high pH range, the 1%, 5% and 18% cobalt-nickel deposits are brilliant and become whiter as the cobalt concentration is increased. The high cobalt deposits are noticeably blue-white in color. In the low pH range, the deposits are truly semi-bright. Buffing of semi-bright deposits will be discussed later.

The cobalt-nickel deposits have a fine structure which is difficult to resolve, even under fairly high magnification. Young reports that of all commercial bright nickel deposits which he etched for examination, the cobalt-nickel deposits were the most difficult to etch satisfactorily for bringing out the structure. The heavy lamination associated with organic type brighteners is not present in the cobalt-nickel structure.

The cobalt-nickel deposits do not require activation prior to chromium plating.

In speaking of the hardness of deposits, one must differentiate between two different types of hardness — the metallurgical hardness that is determined with a hardness tester and the hardness that is associated with buffing. The cobalt-nickel deposits show a Vickers hardness higher than ordinary nickel deposits but are not as hard as some deposits from baths with

organic brighteners. Fig. 1 illustrates the hardness of the 1%, 5% and 18% cobalt-nickel deposits.

Although the cobalt-nickel deposits are somewhat harder than deposits from warm nickel baths, they are not abnormally stressed and, therefore, plated articles can be deformed severely without rupture of the coating. In fact, the first installation of 18% cobalt-nickel was made in a plant where the articles were plated and then subsequently formed in a press to make the final product. Another example — cobalt-nickel deposits can be applied to a ⅜" diameter cold rolled steel rod such as is used in making hand braces, the wooden handle slipped on, and then the braces bent to a 90 degree angle. The deposit does not flake off and presents a good appearance on the bend after this abuse.

The high pH cobalt-nickel deposits do not ordinarily require buffing. On bumper bars or similar articles, where a heavy nickel is applied, and the article is buffed to cover up defects in the metal underneath, the low pH bath is used. This produces the softest and most easily buffed deposits. The savings in buffing costs will be discussed later.

Fink and his co-workers report somewhat higher corrosion resistance with nickel-cobalt deposits than with straight nickel. Fig. 2 shows the results of atmospheric corrosion tests on the 18% cobalt-nickel coat-

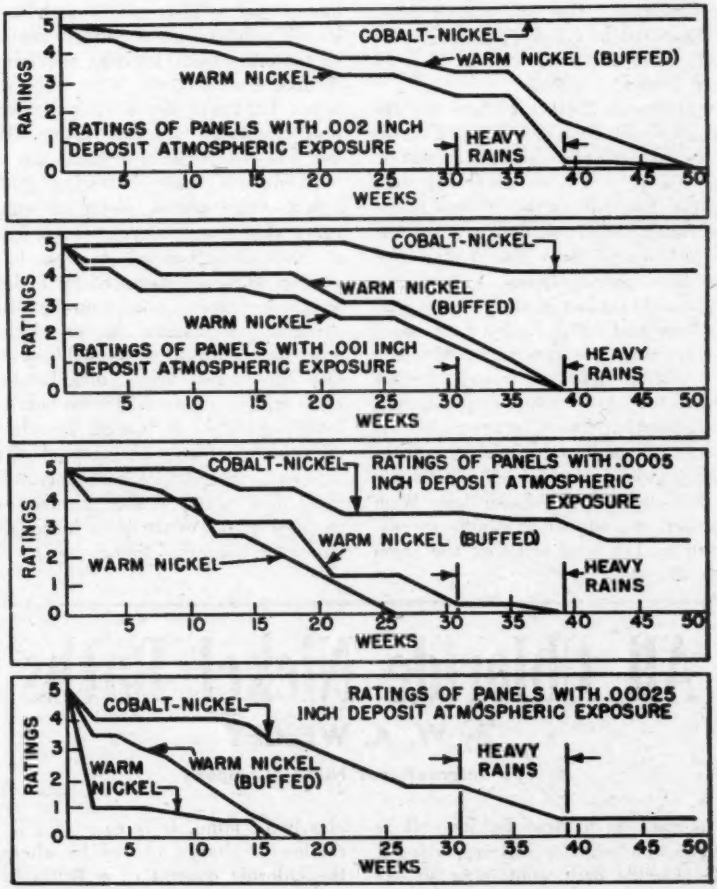

Fig. 2. Protective value of cobalt-nickel and Watts nickel deposits in outdoor exposure.

ings versus coatings produced in the Watts nickel bath. Four different thicknesses of deposit from 0.00025 inch up to 0.002 inch were tested. These tests required about two years of completion, but the charts only show a little less than a year's exposure. The cobalt-nickel deposits are more protective than the Watts nickel deposits both as plated and after buffing. Despite the metal loss incurred during buffing, the buffed deposits are more protective than the unbuffed Watts nickel coatings.

Cost of Operation

To speak of the costs of operating one particular nickel solution as against other types, is to invite controversy. However, it can be stated that under average good operating conditions, the 1% cobalt-nickel can be deposited in volume production for a total chemical and anode cost of 53 to 54 cents per pound of alloy.

There are many factors to consider besides anodes and chemical costs. For example, in one plant plating automobile bumper bars in a 1% cobalt-nickel solution at the low pH value, it was found that the cobalt-nickel solution was less expensive to operate than the Watts type low pH bath previously used. With the 1% cobalt-nickel solution, truly semi-bright deposits were had which buffed with much greater ease than the gray nickel deposits obtained earlier. Whereas a can of lime composition used to be required for buffing eight bumper bars with gray nickel, it lasted long enough for finishing thirty bars plated with cobalt-nickel. With the gray nickel, the buff lasted two days. With cobalt-nickel, the life of the buff was extended up to 1½ weeks. Using the same equipment, 15% more production was obtained per hour per buffer and there was a 20% increase of production from the tanks — all with far fewer rejects. All of these factors must enter into a calculation of total cost.

Relative cost of deposition is indicated by the extent to which there is a shift from one process to another, especially by those who plate to rigid specifications.

Applications

Cobalt-nickel deposits have been applied to almost every type of article on which nickel is plated. The objects vary in size from small watch parts to automobile bumper bars and tubular metal furniture. Among the plated products are, on one hand, quality instruments such as microscopes, refractometers and cystoscopes and, on the other hand, low-cost merchandise including kitchen tools or utensils, miscellaneous hardware items such as wrenches, toys, bathroom accessories, etc. The 1% and 5% cobalt-nickel deposits are used extensively on brass plumbing goods, insignia, name plates, electrical appliances, roller skates and bicycle parts. The harder 18% cobalt-nickel coating has been applied to record stampers, for facing stereotypes and for use in food handling machinery. An installation for plating tubular metal furniture is believed to contain the largest bright nickel solution in the world — the total volume being around 49,000 gallons. A rough calculation indicates that the production of chairs on this and other similar conveyors will, within a few years, enable almost everyone in the country to sit down in cobalt-nickel chairs at the same time.

All Chloride Nickel Baths

By W. A. WESLEY

The International Nickel Company

MY purpose is to describe, as well as I can, the behavior and properties of a simple chloride bath, containing 40 oz/gal. of nickel chloride and 4 oz/gal. of boric acid. With the properties of that bath clearly in mind, it is easy to tell the direction of change caused by alteration of the chloride content of a Watts bath, the benefits derived from the change and the difficulties which might be encountered.

Anode Behavior

As far as is known, all types of nickel anodes corrode in the chloride bath with 100% anode efficiency. At a low pH and with free circulation of the electrolyte around the anode, the upper limit to the anode current density has never been reached even above 1,000 amp/sq.ft. This statement does not indicate whether the anode becomes rough or stays smooth. It simply means that the anode does not become passive and that the nickel content and pH of the bath do not fall.

Plate Characteristics

Deposits from the chloride bath are smoother, finer grained, harder and stronger than those from the Watts bath. This is particularly noticeable in the deposition of very heavy coatings where the tendency to form nodules and trees is amazingly less in the high chloride bath. In fact, there is a range of conditions in the neighborhood of pH 1.5 and at high current densities, where semi-bright deposits are obtained which can be buffed without previous polishing.

The protective value of nickel deposits is about the same, regardless of the chloride content of the bath. Deposits on steel show about the same salt spray rating and outdoor atmospheric test ratings whether produced in the all chloride bath or in the Watts bath.

Bath Characteristics

It is well established that, other factors remaining constant, cathode efficiency increases with the increasing chloride content. For example, at pH of 2, 130°F and 50 amp/sq.ft., the Watts bath and the chloride bath show about 97 and 99½% efficiency respectively. At 5 amp/sq.ft. the efficiencies are 90 and 98%. Another way to look at it is to calculate the amount of hydrogen produced. In the first case of 50 amp/sq.ft., the Watts bath uses 3% of the current to produce hydrogen and the chloride bath 1/6 of that amount or about ½%. In the second case of 5 amp/sq.ft., the figures are 10 and 2% respectively.

To demonstrate the difference between the chloride and the Watts bath in respect to cathode polarization, one may plot the potential against the current density. The curve for chloride bath has the steeper slope. On log paper one obtains two straight lines with a slope in case of the Watts bath of .053, and in case of the chloride bath is .072.

The chloride bath has about twice the conductivity of the Watts bath. As a consequence there is less heating of the bath when higher current densities are used, and just about half as much heat is generated at a given current density. The conductivity of the Watts bath is .09 as compared to .18 with the chloride bath.

In spite of Dr. Kasper's statements about throwing power theory and measurements, it is safe to predict that if all three factors which Haring and Blum have shown to determine throwing power: cathode current efficiency, cathode polarization and conductivity are more favorable in one bath than in another, the former will have the better throwing power. Here the slopes of the cathode polarization-current density and the cathode current efficiency-current density curves for the chloride bath are the higher, and the conductivity is higher. Hence the chloride bath will show better throwing power, no matter what the cathode shape.

Since the conductivity of the chloride solution is high, tank voltage is low and permits a higher cathode current density to be used at a given generator voltage. That a very large portion of the tank voltage is used in overcoming the resistance of the solution is easily shown. With 100 amp/sq.ft. in a tank of given size and anode-cathode distance, the IR drop through a Watts bath may be 11 volts, the anode polarization one-half to one-tenth volt and the cathode polarization about one-half volt for a total of 12 volts. For the chloride bath in the same tank, the corresponding IR drop instead of 11 will be 5½ volts, the anode polarization 0.3 to 0.1 volt and the cathode polarization 0.4 volt. Hence the total tank voltage is about 6.2 volts — roughly half of that for the Watts bath.

As far as we have been able to find out to date in studying nickel plating at very high current densities, the upper limit of cathode current density for good deposits is well above any that could be reached practically. In other words, the maximum velocity at which one can make nickel

ions move through the solution is not a limiting factor. The current which can be supplied in any practical case is. Available generator voltage and the problems of making contacts and connections for large currents and of keeping the bath from boiling are the factors which limit the amount of current which can be employed. The main operating requirement for use of high current densities is sufficient agitation.

I have here a piece of steel with a 0.001 inch thick nickel coating. It was plated in 16 seconds. Both anode and cathode current densities were 4,000 amp/sq.ft. The nickel is of good quality.

The first disadvantage of the chloride bath is its corrosiveness which is much higher than that of the Watts bath. Lead linings and lead coils cannot be used. As a matter of fact, no available material is fully satisfactory for heaters and pumps. However, some valuable alloys are expected to reach the market soon. The regular rubber and synthetic linings for bright nickel solutions are suitable.

The second disadvantage is that the stress in nickel deposits increases with the chloride content of the bath. It is greatly influenced by the presence of impurities. The ductility decreases somewhat with increase of chloride content but, at least in our experience, those who have complained about brittleness of the nickel deposits always have plated from impure baths.

Applications

As in all practical plating, the bath composition and operating conditions should be adjusted for maximum advantage with minimum disadvantage. There are types of work for which a bath containing no chloride at all is the best, while other types of work may make it advisable to employ an all chloride bath. When freedom from nodules, high current densities and high throwing power are desired, the high chloride bath should be chosen. It has been used commercially in plating deposits 0.006 to 0.007 inch thick at 200 amp/sq.ft. It is also used in a plant where steel furniture is being plated in the daytime and salvage work is done at night. There has been some use of the chloride baths in the deposition of heavy nickel deposits on plastics and on aluminum. When maximum ductility or freedom from stress is needed, chlorides should be kept as low as possible.

It is recommended that these things be kept in mind when ordering plating tanks and equipment. One may find oneself wanting to go to a higher chloride content one day and it will be easy to do so if equipment has been purchased with that in mind.

High Speed Nickel Baths

By W. C. PINNER

Houdaille-Hershey Corporation

PRIOR to the publication of Dr. Wesley's original paper on the all-chloride plating solution, I was privileged to review this development with him at the Research Laboratory of the International Nickel Company. It will be recalled that four different types of deposits, namely, a dark matte deposit, a light matte deposit, a so-called semi-bright deposit and a semi-bright deposit containing microscopic cracks, were obtained depending upon the temperature-current density-pH relationship.

The so-called semi-bright deposit was of interest to us inasmuch as it appeared to have buffing properties similar to those of a plate obtained from a normal Watts plating solution. We found that in an all-chloride bath we were able to plate nickel at substantially twice the current density that can be used in the regular Watts bath. In addition, we subsequently found a set of brighteners compatible with a high chloride content, so that our work led to the development of a high speed bright nickel plating bath.

Mixed Sulphate-Chloride Bath

Dr. Wesley has listed several advantages of the all-chloride nickel plating solution. We found all of these advantages to exist,

but were faced in production with two particular disadvantages. One involved a rapidly changing pH, the other difficulty in neutralizing the solution so as to reach a pH higher than 5.0 for the purpose of purification. Dr. Wesley had predicted that if a high chloride content were maintained and nickel sulfate were added to the bath, the ductility of the deposit might be improved. Our development showed this prediction to be correct. We also found that when nickel sulfate was added to a high chloride bath, the two disadvantages mentioned ceased to exist.

Bath Composition

Fig. 1 presents the information obtained in our evaluation of baths containing different amounts of nickel chloride. In any particular bath, as temperature or pH or both are decreased, there will be obtained in order the dark matte, the light matte, and the semi-bright deposits. Finally, as temperature or pH or both are decreased still further, the deposit becomes cracked or burned.

The relationship shown in Fig. 1 exists in a plating system at an average cathode

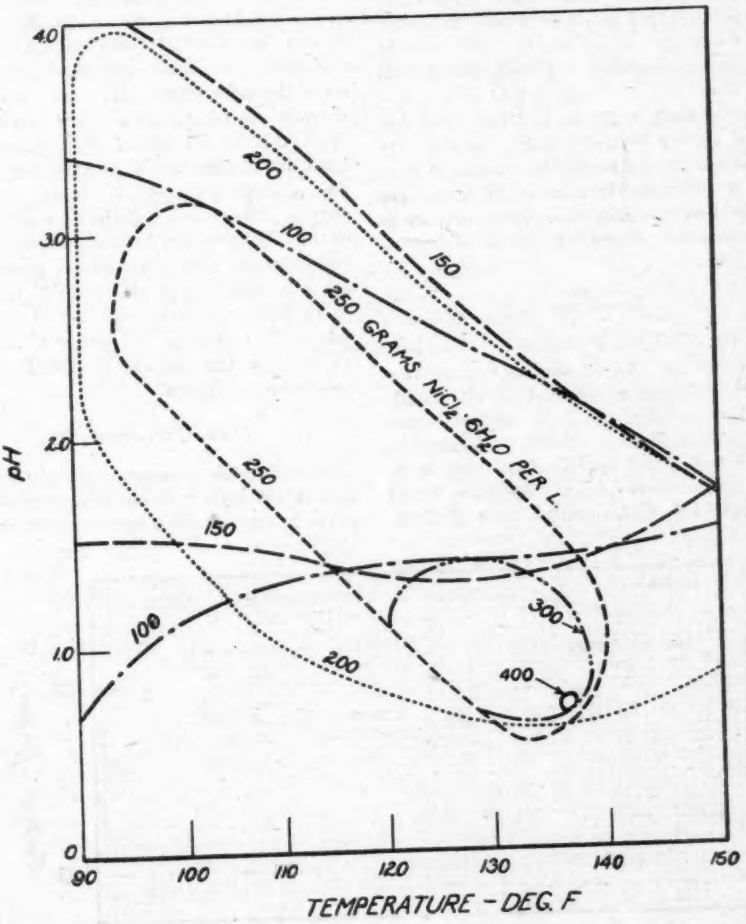

Fig. 1. Effect of nickel chloride content on range for ductile semi-bright deposits at 100 amp/sq.ft.

current density of 100 amp/sq.ft. The range for pH and temperature in semi-bright plating is very restricted in a bath containing as much as 400 g/l of nickel chloride. As the nickel chloride content decreases, the range widens, and baths containing from 150 to 200 g/l of nickel chloride present the widest range. On the basis of these data, we selected a concentration of 175 g/l of nickel chloride and used it in our further investigations.

Our work resulted in the following bath composition which we consider to be optimum, namely 200 g/l nickel sulfate, 175 g/l nickel chloride, and 40 g/l boric acid. Based also on the data shown, we selected an operating pH of 1.5 at a temperature of 115°F. In this solution, the pH remains sufficiently constant to permit commercial operation.

The deposit is not as ductile as that obtained from a Watts bath, but the ductility appears to be sufficient for decorative plating. A considerable number of tests have shown it to have corrosion characteristics as good as those of coatings obtained from a Watts bath.

Equipment

As Dr. Wesley has pointed out, it is necessary that no lead be used as construction material inasmuch as lead is chemically soluble in a solution of this chloride content. The equipment should preferably be rubber lined, and special alloys should be used in the filter pumps. We have found that nickel-chromium alloys such as R-55, Worthite, and Illium may be used as a material of construction for pumps. Heating of the solution is preferably accomplished by means of Karbate heaters or heat exchangers. Pitting can be controlled by the use of either peroxide or a wetting agent. If a wetting agent is employed, one must be very careful that there be no conductor in the solution which might act as an insoluble anode and cause evolution of chlorine gas.

Rapid Bright Plating

We then found that the basic solution could be used in conjunction with the organic brighteners covered in the Brown Patent No. 2,191,813. We do not presume to state that these are the only useful ones because time did not permit a thorough investigation of other brighteners. With this bright nickel plating bath, we have in production plated nickel at the rate of 0.001 inch per 11 minutes. On high current density areas, perfectly usable plate of this thickness has been obtained in about four minutes. The bright nickel plating solution is usable in a pH range of from 2.0 to 5.0 and possibly beyond these limits. We selected an average pH value of 3.0 and an average temperature of 140°F as our preferred conditions.

Plate Characteristics

An interesting characteristic of this bath is that the high chloride concentration appears to suppress the formation of nodules

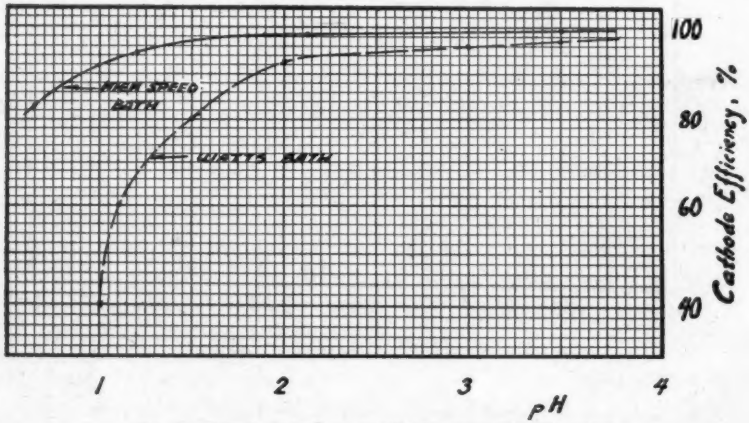

Fig. 2. Effect of pH on cathode current efficiency.

in the plate. This is, of course, particularly advantageous in bright plating and appears to be characteristic of the high chloride bath as distinguished from bright nickel solutions containing what had been regarded normal concentrations of chloride. The physical properties of the deposit appear to be equal to those obtained from any other organic type bright nickel solution.

The same kind of equipment is used with this bath as with other bright nickel solutions, with, of course, the same consideration given to special equipment as has been noted for high speed dull plating baths.

Cathode Efficiency

Dr. Wesley has already mentioned that higher cathode efficiencies are obtained in baths containing high concentrations of chloride. Fig. 2 presents data on cathode efficiencies in the high speed bath and the standard Watts solution at varying pH and temperature. For example, a Watts solution containing 4 oz/gal of nickel chloride has a cathode current efficiency of about 40% at a pH of 1.0. The corresponding value for the high chloride solution is of the order of 86%. At a pH of 1.5, the efficiency of the high chloride bath is 97%, whereas that of the Watts bath is of the order of 85%. It is of very great interest that such high efficiencies can be obtained in baths which at the same time have the clarity of a highly acid solution.

. . . GENERAL DISCUSSION . . .

Question: Is it possible to control the brightener in a nickel solution with a Hull cell?

Mr. Martin: We have found in actual practice that it is not practical. Instead, for control purposes we have found it desirable to use the electrophotometric type of analysis, in which material is analyzed, not gravimetrically or volumetrically, but by the development of a color.

Mr. Pinner: I might suggest that when a bright nickel solution is on the ragged edge of misbehaving, one can get information by using the bent cathode test as a means of determining quickly what one has to do with the solution.

Question: What is the anode efficiency of the cold, dull nickel bath?

Mr. Mattacotti: I have no figures on what that would be, but from the anode behavior I would say that the anode efficiency, assuming 3 oz./gal of ammonium chloride, would be close to 100%.

Question: There is a difference in the covering power of chromium when it is deposited on a freshly plated bright nickel and when it is deposited on a buffed bright nickel. How can the surface be activated so as to eliminate this difference?

Mr. Martin: Buffed bright nickel should not be cleaned anodically.

Mr. Pinner: I have not observed any difference in the covering power of chromium on bright nickel, whether it be buffed or not, provided that an adequate cleaning procedure is used for the nickel. This cleaning procedure involves cathodic cleaning in alkali, rinsing, acid dipping, preferably in sulfuric acid, and rinsing in water slightly acidified with sulfuric acid.

Mr. Diggin: We have run into cases where chromium has refused to deposit over heavily buffed hard nickel deposits. Where a great deal of heat is generated, there is formed a slight oxide film on the nickel surface. The difficulty has been overcome in the pre-cleaning cycle prior to chromium plating by treating the nickel surface in fairly strong hydrochloric acid rather than in sulphuric acid. Another good treatment is cathodic activation in a sulphuric acid pickle. In some cases, the difficulty can be attributed to impurities in the nickel solution. The remedy in this case, of course, is not to try to make the nickel receptive to chromium by special treatments, but to go back and clean up the plating solution.

Question: What is the limiting amount of current that can be used in nickel plating with reference to the solution volume?

Mr. Phillips: There is no limit as such. Dr. Wesley has shown that in a chloride bath one can use a great many more amperes per gallon than in the Watts bath. Temperature, solution concentration and a

number of other factors control. In some cases 50 amperes per gallon could be used.

Mr. Pinner: In other words, the limiting current concentration is very much higher than would be permitted by other factors in the production of a good nickel deposit.

Question: Can a bright cobalt-nickel deposit be plated on cadmium? How is the corrosion resistance of the cadmium affected?

Mr. Diggin: I have never tried it since I can not find any use for such a sequence of coatings. Some years ago platers attempted to nickel plate over zinc plated steel with the thought of using the zinc for corrosion protection and the nickel for appearance. Similar attempts have been made with cadmium in place of zinc. This sequence is usually unsatisfactory because the cadmium and zinc in protecting the steel will form corrosion products which occupy greater volume than the metal and eventually bleed through and rupture the nickel coating, unless the nickel is extremely heavy and free from porosity. In that case, you wouldn't need cadmium underneath. If the nickel is pore-free, perhaps nickel alone would suffice in this case.

Speaker from the floor: We use 0.0002 inch nickel over 0.0002 inch cadmium to prevent finger staining and to give a nicer, longer lasting appearance. About 150 hours can be had in the salt spray. We are trying to push it up to 200 hours and are interested in cobalt-nickel for the reason that you say that the porosity of the cobalt-nickel is considerably less than that of plain nickel. Can you obtain a bright cobalt-nickel deposit on unbuffed bright cadmium?

Mr. Diggin: I imagine that you could apply it without difficulty. It is just a question of how many hours of exposure would be required in the salt spray, atmosphere or humidity tests and what you would be satisfied with in regard to the final appearance of the article. The result would depend, of course, upon the thickness of the cadmium and the nickel.

Speaker from the floor: If we can get 150 salt spray hours with ordinary nickel, do you think that we could get 200 with cobalt-nickel?

Mr. Diggin: I don't know. We would have to try it and so would you.

Mr. Mattacotti: The question of high salt spray resistance brings to mind work done before the war that we are beginning to hear about again. I am referring to the reversal of the suggested coatings. Deposition of nickel, followed by deposition of zinc or tin and heat treatment at about 700° is the process known as corronizing. Claims made indicate rather high salt spray resistance where appearance is not the determining factor.

Mr. C. F. Nixon: Can you account for the presence of cobalt in plating solutions that were not prepared as cobalt-nickel plating solutions?

Mr. Diggin: All nickel anodes contain cobalt as well as nickel. The bath eventually comes to an equilibrium with the cobalt in the anodes. In fact, in the early days of cobalt-nickel plating, we had an installation of 18% cobalt-nickel for the plating of parts for the Federal Government. These had to pass tests at the Bureau of Standards. Some of the parts sent there for tests were about 18% shy on the nickel thickness and this finding consequently caused the rejection of the entire production. The Magne-Gage tests or electrolytic methods for determining the thickness of coating would demonstrate that the full thickness was applied. The nickel, however, was determined by the dimethylgloxime method which did not take into account the amount of cobalt present. In all specifications you will find nickel plus cobalt, either expressed or implied. If you buy nickel anodes, you buy them on the basis of nickel plus cobalt. The amount of cobalt in ordinary nickel anodes will vary according to the amount of cobalt in the ore — it may run 0.4% to 0.5% cobalt, at times higher. In newly prepared cobalt-nickel solutions, we use a higher cobalt concentration than is required for normal operations. For example, in the 1% cobalt-nickel solution, the normal cobalt sulphate concentration is about 0.2 oz/gal. In a new solution, we purposely make it about 0.35 oz/gal, because the anode efficiency may be low at the start, especially with cast anodes. Also, the increased cobalt content helps to compensate for and mask the effects of metallic impurities which may be present initially.

(*Continued on page* 526)

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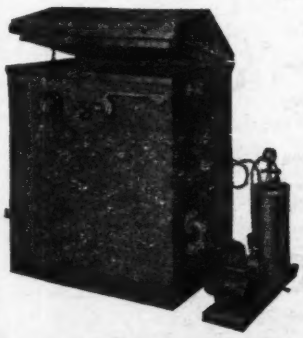

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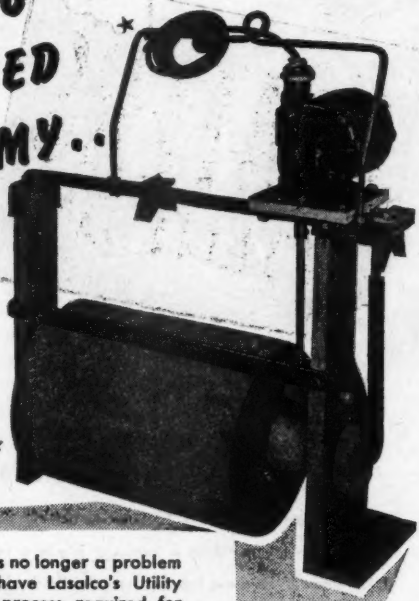

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The Purification of Electroplating Solutions

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Chief Chemist, Hanson-Van Winkle-Munning Company
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INTRODUCTION

IT is reasonably safe to state that the majority of difficulties in electroplating arise from the presence of impurities in the baths. To obtain consistent results in respect to appearance, physical properties, adhesion, and corrosion protective qualities, it is essential that the solution is in good chemical balance and does not contain impurities in harmful quantities, and that reasonably constant operating conditions be maintained.

In the early days of bright nickel plating, it was found that the successful operation of commercial processes depended upon initial and periodic treatment of solutions to reduce the concentration of both organic and inorganic impurities, and upon the installation being engineered so as to prevent contact of the solution with metals or nonmetals which would cause contamination.

During the war period, cadmium and zinc solutions were purified as never before to facilitate production of uniformly appearing deposits. Although shaded or cloudy deposits would probably give the corrosion resistance required by the specifications, untrained inspectors were not sure of this and therefore rejected parts that were not evenly bright in appearance. In the present post-war period, specifications for the thickness of nickel deposits have been increased and as a result, especially when high carbon steel is being plated, it is more important than ever that the physical properties of deposits be controlled by plating under rigorously regulated conditions.

Several articles have been published on the subject of the effect of impurities in plating solutions[1]. A great deal of information will undoubtedly be obtained from private sources in connection with A.E.S. Research Project No. 5.

An impurity may be defined as any material in an electroplating solution which adversely affects the physical appearance or properties of the deposits.

CLASSIFICATION AND SOURCES OF IMPURITIES

One may conveniently classify the impurities on the following basis:

Inorganic impurities in solution — common metallic impurities. Typical sources are salts and make-up water; metallic dusts and dirt; chemical or electrolytic action on metallic tank walls; drippings on tank rods; dissolution of metals being plated or dropped in tanks; accidental additions of wrong salts; pigments or occluded solutions in rack coatings; carry-in from strike solutions or pickles; improper choice of materials in accessory equipment; decomposition or conversion of chemicals normally present in the bath.

Organic impurities in solution. Among sources may be mentioned — decomposition products of brightening and wetting agents or an overdosage of either; untreated anode bags; material extracted from tank lining, connecting hose, filters or rack coatings; solvents from protective paints in contact with or near the plating solution; paint sprays or buffing dusts in vicinity of plating tank; salts; wood, leather, animals and insects; water supply; buffing compounds, etc. on unclean work.

Organic and inorganic solids and dispersed impurities. These derive from dust or dirt from atmosphere; slimes and metallics from anodes; insoluble components of bath chemicals; abrasives and dirt through improper cleaning; rust and dirt in make-up water; supersaturation and precipitation of chemicals in bath; oil, grease, rust or paint from equipment; mold growths.

Organic and inorganic gaseous impurities. Examples are carbon dioxide in nickel sol-

TABLE I

Effect of Iron in Cyanide Cadmium Bath

Cadmium	— 2.5 oz/gal	NaOH	— 0.0 oz/gal
Free NaCN	— 9.0 " "	Brightener	— 1.0 " "

Iron as $K_4Fe(CN)_6.3H_2O$ oz/gal	Cathode Efficiency %	Resistivity ohm/cm³	Appearance of Deposit	
			As Plated	Bright Dipped in 1% HNO_3
0.00	94.0	6.99	Excellent	Brighter
0.25	94.0	6.70	Excellent	Brighter
0.50	94.1	6.50	Good	Dull*
1.00	94.5	6.15	Good	Dull*
1.50	96.0	5.84	Sl. hazy, gray	Dull*
2.00	96.0	5.60	Sl. hazy, gray	Dull*

*The addition of minimum of 1.0 oz/gal NaOH offsets dulling in bright dip caused by iron.

utions from treatment with carbonates; dissolved air released upon heating; finely dispersed air aspirated through packing gland on filter or circulating pump; hydrogen gas adhering to cathode.

DETECTION OF IMPURITIES

No attempt will be made to give methods of analysis since in 90% of the cases direct chemical analysis is not required. The nature of the impurities can, in most cases, be determined by physical observations or by bent cathode or Hull Cell tests.

CLASSIFICATION OF REMOVAL METHODS

Filtration. Modern practice is to turn over the solution once every 2-3 hours. "Brilliant" filtration is essential for the production of heavy deposits.

Oxidation or reduction with potassium permanganate and hydrogen peroxide in nickel and acid copper solutions, with hydrogen peroxide in tin and cadmium solutions, and with sodium thiosulphate and bisulphide in copper and brass solutions.

Precipitation of iron in nickel solutions, copper and lead in zinc solutions, etc.

Adsorption (sometimes preceded by oxidation) with activated carbon and clay to remove organics.

Selective electrolysis of nickel solutions. So-called "ageing" of solutions is selective electrolysis.

Treatment with ion exchange resins and minerals for the reduction of hydrogen ion bisulphite in copper and brass solutions.

EFFECTS OF IMPURITIES IN VARIOUS SOLUTIONS AND THEIR REMOVAL

The concentration which causes trouble depends upon many factors, i.e. solution composition, temperature, current density, nature of brightener and of article being plated. The standardization of removal methods will depend, to some extent, upon the standardization of plating solutions.

Cadmium Cyanide Solutions

Iron exists in cadmium solutions as sodium ferrocyanide, $Na_4Fe(CN)_6$. An increase in the iron concentration increases the cathode efficiency and decreases the bath resistivity (Table I). At about 0.5 oz/gal. (3.7 g/l), the brightness of the deposits from NaOH-free solutions containing addition agents decreases noticeably. Such deposits turn dull when bright dipped in nitric acid. At 1.5 oz/gal. (11.2 g/l), the deposits are slightly hazy and gray as plated and dull when bright dipped. As little as 1 oz/gal. (7.5 g/l) of caustic soda added to the bath will overcome the detrimental effects of iron.

Sodium ferrocyanide is a stable compound and cannot be removed by electrolysis or by chemical reaction. Its concen-

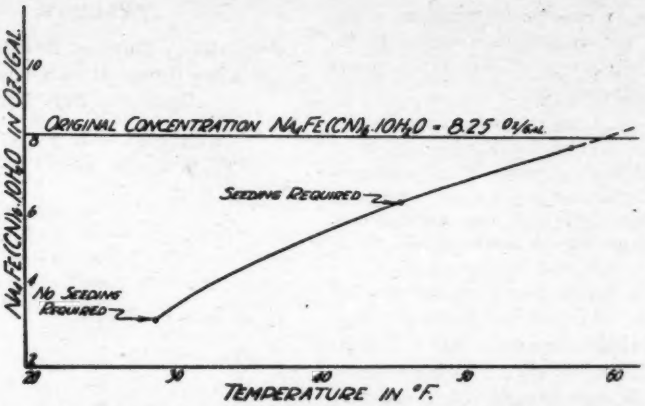

Fig. 1. Solubility of sodium ferrocyanide in cadmium cyanide solution containing 2.3 oz/gal. cadmium, 9.0 oz/gal. free sodium cyanide, 1.7 oz/gal. caustic soda and 0.3 oz/gal. anhydrous sodium carbonate.

tration can be lowered by the "freezing out" method.

Fig. 1 illustrates the reduction of sodium ferrocyanide content by cooling a solution containing 8.24 oz/gal. (61.8 g/l) of $Na_4Fe(CN)_6$. At 46°F (7.8°C), there remains in solution 6.56 oz/gal. (49.2 g/l), and at 29°F (—1.7°C), only 3.25 oz/gal. (24.4 g/l).

Copper causes deposits to turn off-color upon bright dipping. Where this occurs, the chromic acid dip is preferred over the nitric acid bright dip. Copper lowers the throwing power. It is co-deposited with cadmium only at abnormally low free sodium cyanide concentration.

Treatment of standard cadmium solutions with cadmium dust or freshly precipitated cadmium sponge is not effective (Table II), contrary to reports in the literature. Zinc dust does not remove copper (Table III) when it is added to a cadmium solution, since a spongy cadmium immersion deposit coats the zinc particles completely.

Selective electrolysis at low cathode current density is also ineffective. Table IV illustrates the negative results of electrolyzing a cadmium solution successively at two low cathode current densities.

Copper can be removed electrolytically if the free sodium cyanide concentration is first lowered to 1.0-1.5 oz/gal. (7.5-11.2 g/l). This method appears impractical.

Lead causes the deposits to be dark and difficult to bright dip and may cause abnormal anode polarization. The upper permissible limit is 0.03 oz/gal. (0.22 g/l).

TABLE II

Effect of Cadmium Dust Treatment on the Removal of Copper from Cadmium Solution

Original copper content 0.20 oz/gal.

Cadmium Dust lb/100 gal.	Treatment Time minutes	Copper Remaining oz/gal.
2	20	0.201
5	20	0.204
10	20	0.202
10	120	0.202
10	120	0.199

TABLE III

Effect of Zinc Dust Treatment on the Removal of Copper from Cadmium Solution

Original copper content 0.190 oz/gal.

Zinc Dust Addition lb/100 gal.	Treatment Time minutes	Copper Remaining oz/gal
2	20	0.191
4	120	0.192

Lead can be removed by treatment of the bath with sodium sulphide followed by filtration. There is small loss of cadmium by this treatment.

Zinc is not particularly troublesome. High concentrations will turn otherwise bright cadmium deposits to a dull-gray color. Zinc dust precipitates cadmium sponge which eventually causes roughness.

Zinc codeposits with cadmium and, therefore, can be removed by electrolysis.

Nickel is not a commonly encountered impurity in cadmium solutions. A small amount, 0.015-0.030 oz/gal. (0.11-0.22 g/l), has a brightening effect. Large amounts cause the deposits to turn yellow and may intefere with bright-dipping.

Nickel is slowly codeposited with cadmium at high current densities.

Thallium causes a pulsating polarization at the anode. At concentrations of 0.01-0.10 oz/gal. (0.075-0.75 g/l), the polarization is increased appreciably. Above 0.10 oz/gal (0.75 g/l) deposits are spongy and anodes slime heavily (Table V).

No satisfactory method is known for the removal of thallium from cadmium baths.

Hexavalent chromium in concentrations of up to 0.02 oz/gal. (0.15 g/l) does not lower the cathode efficiency but causes "spotty" deposits on steel.

Chromium can be removed by treating the cadmium solution with sodium hydrosulphite, $Na_2S_2O_4$, known commercially as Vatrolite or Lycopon, as described by Beckwith[2]. Added to an alkaline cyanide plating solution, it reduces hexavalent chromium to the harmless trivalent state. Quantities suggested for treatment of contaminated solutions vary from 0.007 to 0.07 oz/gal. (0.05 to 0.5 g/l).

TABLE IV

Effect of Low Current Density Electrolysis on Removal of Copper from Cadmium Solution

Cadmium — 2.3 oz/gal
Free NaCN — 9.0 " "
NaOH — 1.7 " "
Na_2CO_3 — 0.5 " "
Copper — 1.552 g/l

Current Density amp/sq.ft.	Time hours	Copper Remaining g/l
1	2	1.548
1	4	1.542
3	2	1.547
5	2	1.547

NOTE: Lowering Free NaCN to 1.0 oz/gal. will cause copper to be deposited.

Organics. When Turkey Red Oil is used as a brightener, slimy mold growths have been observed which cause uneven deposits. Other organic materials cause cloudy, dark, uneven and pitted deposits.

Treatment with activated carbon restores the bath to good condition in most cases. The carbon also adsorbs organic brighteners which must be replaced after treatment. The addition of 0.25-1.0 ml/l hydrogen peroxide has been found to be effective in selectively oxidizing certain organic contaminants.

Chromium Solutions

Copper forms a colloidal chromate and may interfere with analysis. Maximum permissible copper content is 2.0-2.7 oz/gal.

TABLE V

Effect of Thallium in Bright Cyanide Cadmium Plating Solutions

Thallium as $Tl_2(SO_4)_3.7H_2O$ g/l	Cell Voltage		Appearance of	
	Start	End	Deposit	Anode
0.000	0.6	0.6	Good	Light gray
0.001	0.6	0.6	Good	Light gray
0.010	0.6	0.6	Good	Light gray
0.100	0.8	1.4	Poor	Dark gray
1.000	0.8	1.5	Spongy	Dark gray

No satisfactory methods are known for the removal of copper.

Iron in moderate concentrations such as 0.5 oz/gal (3-4 g/l), improves the ability of chromium to cover cast iron. In higher concentrations, it reduces cathode efficiency and throwing power. It narrows the bright plate range and makes it necessary to use higher voltage. Maximum permissible content is 2.0-2.7 oz/gal. (15-20 g/l).

Iron can be removed by electrolysis with a mercury cathode. However, a stiff amalgam is formed which fouls the cathode rapidly. Of academic interest, the method cannot be rated commercially feasible.

Nickel is apparently not harmful. A six to eight inch layer of nickel plated parts on the bottom of the chromium tank was without harmful effect on the deposit.

Zinc in small amounts is said to have a whitening effect upon chromium deposits. Larger quantities are not harmful.

Cadmium is not particularly harmful.

Nitrates and chlorides introduce a high acid radical content. They may restrict the plating range and cause gray deposits.

For the removal of chlorides, raise the temperature and aerate the bath.

Organic contaminants cause hexavalent chromium to be reduced to trivalent.

Filter the bath and use Lukens porous cup method to reoxidize the chromium to hexavalent condition.

Copper Cyanide Solutions

Zinc lowers the cathode efficiency appreciably, especially in Rochelle salt copper solutions. A small amount, such as 0.1 oz/gal (0.75 g/l), in an ordinary cyanide copper solution causes brass to be deposited on the extremely low current density areas of the cathode.

For removal of the zinc, treat the copper solution with small quantities of sodium sulphide, Na_2S, and filter.

Iron exists as sodium ferrocyanide. It produces coarsely crystalline deposits, interferes with the analytical determination of copper and causes abnormal conditions at the anodes.

The concentration of $Na_4Fe(CN)_6$ can be lowered by the "freezing-out" method described for the cadmium solution. Beckwith reports that the harmful effect of high ferrocyanide on the anodes can be overcome by means of treatment with sodium hydrosulphite, $Na_2S_2O_4$.

Cadmium and Silver, when present in concentrations of 0.075 oz/gal. (0.1 g/l) or higher, produce columnar deposits, cause treeing and may cause blistering, especially of deposits on brass.

Both can be removed by treatment with sodium sulphide. Silver can be removed by circulation over copper (or brass) scrap metal or granules.

Nickel in the amount of 0.075 oz/gal. (0.1 g/l) produces a dulling effect upon the deposit.

It is plated out at normal cathode current densities[3].

Hexavalent chromium causes dull copper to be deposited, reduces the throwing power, lessens the adhesion of copper to steel and lowers the efficiency. At a concentration of 0.005 oz/gal. (0.04 g/l), the efficiency is reduced 20 per cent, at 0.02 oz/gal. (0.15 g/l), it becomes zero (Table VI).

TABLE VI

Effect of Hexavalent Chromium in Cyanide Copper Plating Solution

Chromium g/l	Appearance of Deposit	Nominal Cathode Efficiency, %
0.010	Normal	100
0.020	Normal	100
0.030	Normal	100
0.040	Dark	80
0.050	Dark	70
0.060	Dark	—
0.070	Dark	60
0.090	Dark, poor adhesion	40
0.100	Dark, poor adhesion	—
0.150	—	0

Use sodium hydrosulphite as described by Beckwith[2] to reduce hexavalent chromium to trivalent.

Lead in small concentrations, 0.007 oz/gal. (0.05 g/l), brightens copper deposits. In larger quantities, 0.013 oz/gal. (0.1 g/l), it causes severe roughness of the deposit and abnormal anode polarization. Copper deposits produced in a bath containing lead cannot be colored black in sulphide solutions.

TABLE VII

Effect of Copper in Cyanide Zinc Solution

Copper oz/gal.	Appearance of Deposits		Overall Results
	As Plated	Bright Dipped in ½% HNO_3	
0.0075	Noticeably darker	Unaffected	Excellent
0.01	Very dark brown	Slightly cloudy	Barely acceptable as bright dipped
0.02	Dark brown	Slightly cloudy	
0.03	Dark brown	Cloudy	
0.04	Lighter, matte	Very cloudy	Dull deposits not acceptable
0.05	Dull gray	Matte	
0.075	Matte gray	Matte, sl. cloudy	
0.10	Matte gray	Matte, dark	
0.15	Matte gray	Brownish-black	Black deposits
0.20	Matte gray	Black	

Lead can be removed by treatment with sodium sulphide or by electrolysis.

Silicates cause spotty and dull deposits in cyanide-caustic bright plating baths operating at 180°F.

Continuous filtration through cellulose floc as filter-aid gradually removes silicates.

Mercury amalgamates with the anodes, preventing them from dissolving normally. It may also produce bright spots on the parts being plated.

To remove mercury, filter the solution through copper shot or powder, clean the tank and heat the anodes in a furnace to volatilize the mercury.

Organic impurities in cyanide copper solution cause streaked and ridged deposits and burning on high current density areas. Some brighteners decompose into particles which are adsorbed on the cathode and lower the conductivity of the copper deposit.

Treatment of the solution with activated carbon is usually effective for the removal of organics. Reducing and oxidizing treatments are effective where contamination is not severe.

Acid Copper Sulphate Solution

Iron reduces the cathode efficiency and in large quantities may affect the structure of the deposit.

Iron may be removed by raising the pH to 4.8-5.0 and blowing clean compressed air through the solution. After a few hours, the bath is filtered to remove the ferric hydroxide.

Chloride. Deposits produced in an acid copper solution high in chloride are light-sensitive, are nodular and tend to "tree".

Chlorides can be removed by treatment with silver sulphate.

Organics. Deoxidants extracted from rubber linings may cause deeply ridged deposits. Other organics may produce hard, brittle or dark plates. Phenolsulphonic acid, glue or goulac used in excess may increase the hardness of deposits from 42 to 128 Brinell. Mold growths are particularly troublesome in acid copper solutions, because they lead to formation of non-uniform coatings.

Activated carbon removes many organic impurities. Often a preliminary boiling of the bath with potassium permanganate, $KMnO_4$, is beneficial, especially in the case of mold contamination. The solution should then be filtered through activated carbon.

Zinc Cyanide Solutions

Copper interferes with the production of bright zinc deposits (Table VII). Its effect on deposits as plated is observable at concentrations as low as 0.01 oz/gal. (0.075 g/l). At a concentration of approximately 0.04 oz/gal. (0.30 g/l), the appearance after bright dipping in ½% nitric acid solution is affected. Furthermore, copper immersion deposits are formed on zinc or

zinc alloy anodes, causing an accelerated attack on the anodes by galvanic action. This condition leads to an unwanted increase in metal concentration, and the resulting anode sludge eventually may cause the deposits to become rough.

Copper is effectively removed by treating the zinc solution with zinc dust in proportions of from one to five pounds per 100 gallons of bath and filtering the solution after 20 to 60 minutes. In actual tests on a 2200 gallon zinc solution contaminated with 0.25 oz/gal. of copper, it was determined that 1.0 oz/gal. of zinc dust would remove 0.022 oz/gal. of copper when the solution was treated and hand-stirred for 15 minutes. By using motorized stirring, that is, a motor driven propeller, for two hours, 1.0 oz/gal. of zinc dust removed from 0.05 to 0.06 oz/gal. copper.

This particular solution was so heavily contaminated that it would have required hundreds of pounds of zinc dust to remove all of the copper. The most effective method found for removing the bulk of the copper was electrolysis at low current density of not more than 2 amp/sq.ft. When the copper concentration has been reduced to around 0.04 oz/gal., low current density electrolysis is no longer effective and the solution must be treated with zinc dust to reduce the copper concentration to below safe limits.

Lead interferes with the production of bright zinc deposits and causes sludging of the anodes.

It can be removed by treating bath with sodium sulphide, Na_2S, and also by low current density electrolysis at 2-3 amp/sq.ft.

Antimony causes deposits to blister.

It can be removed by electrolysis. Sodium sulphide treatment is not effective.

Cadmium solution, often accidentally admitted to zinc solution, will cause rough deposits as cadmium sponge will "cement out" on zinc anodes, become detached, and eventually settle on work being plated.

It is removed by treatment of the solution with zinc dust.

Hexavalent chromium in concentrations up to 0.05 oz/gal. (0.4 g/l) and possibly beyond, does not materially reduce the cathode current efficiency of alkaline zinc solutions (Table VIII). At a concentration of 0.002 oz/gal. (0.015 g/l), bright deposits turn to a milky-white color. At all concentrations of hexavalent chromium, the zinc anodes show a brownish film.

Treatment with sodium hydrosulphite, $Na_2S_2O_4$, as described above, causes reduction to the harmless trivalent state.

TABLE VIII

Effect of Hexavalent Chromium in Bright Cyanide Zinc Plating Solution

Chromium g/l	Appearance of Deposit	Nominal Cathode Efficiency, %
0.10	Sl. milky	100
0.20	Milky	99
0.40	Milky gray	97

NOTE: All deposits poorly adherent and all anodes covered with brown film.

Nickel brightens zinc deposits when added in small quantities. Larger amounts harden the deposits and accelerate the corrosion of zinc anodes during idle periods.

Nickel can be removed by electrolysis or by treatment with zinc dust.

Lead Fluoborate Solutions

No reliable information is available regarding the effects of various impurities in fluoborate lead solutions.

Troubles have been experienced in bearing manufacture with *organic* material extracted from rubber linings. This impurity can be removed by treatment with activated carbon. Its effects can be masked by the addition of stable wetting agents.

An excess of glue or an unsatisfactory grade of glue added to the bath will lead to deposits with an unsound structure for bearing purposes.

Silver Cyanide Solutions

Copper in concentrations of 0.25-0.40 oz/gal. (2-3 g/l) does not deposit from silver solutions with normal free cyanide concentration. If the copper concentration is above 1.0 oz/gal. (7.5 g/l), dark deposits will result.

No method for its removal is known.

Iron in small amounts will cause the deposits to stain. In higher concentrations, it increases anode polarization and makes burnishing of deposits difficult. In high concentrations, sodium or potassium ferro-

cyanide may crystallize on tank walls, anodes and articles being plated.

An excess can be crystallized from the bath at low temperatures. No method is known for the removal of residual amounts.

Zinc in small amounts does not interfere with the silver plating process.

Lead and tin codeposit with silver. At a concentration of 0.0025 oz/gal. (0.019 g/l), lead brightens silver deposits; 0.015 oz/gal. (0.10 g/l) and more make the deposits brittle and rough. If the chloride concentration is high, lead deposits as a smut on high current density areas.

Both lead and tin are removed by electrolysis at plating current densities.

Cadmium in small amounts has no effect. In larger amounts, cadmium codeposits with silver to give pink deposits when the cadmium concentration reaches 3%.

Cadmium is removed by electrolysis at normal current densities.

Nickel codeposits only when present in appreciable concentrations. Nickel hardens silver deposits.

No method is known for the removal of small amounts.

Chlorides. In older types of baths made from silver chloride, the attack on unlined steel tanks is accelerated. Exceptionally high chloride concentration leads to the formation of irridescent deposits.

No methods for removal are known.

Nitrates in concentrations of 5.0 oz/gal. (37.5 g/l) and higher are beneficial in silver solutions. They reduce anode and cathode polarization, important when plating with an anode area which is small relative to the cathode area.

Acid fumes. Silver solutions are very susceptible to acid fumes. They evidently cause neutralization on the surface and lead to rough deposits.

Organics. An excess of carbon disulphide, CS_2, brightener may be considered an impurity. Other organic impurities, especially from unsuitable tank linings, may cause dark, rough or streaked deposits.

Treatment with activated carbon is the best method for removing organics.

Nickel Plating Solutions

The presence of small amounts of impurities is most readily observed in bright plating baths. With requirements for production of heavier deposits and better physical characteristics even in dull plating solutions, the control of impurities is essential for consistently successful nickel plating. The maximum permissible limits depend upon the type of solution employed and the applications in which the deposits are to be used.

Copper in baths producing white deposits of ordinary thickness can be tolerated in amounts of 0.05 oz/gal. (0.38 g/l). In bright plating baths the maximum limit is 0.001 oz/gal. (0.0075 g/l), above which effects are evident at low current density.

Electrolysis at a cathode current density of 2-3 amp/sq.ft. is used successfully for removal of copper.

Lead. While lead is only slightly soluble in ordinary nickel solutions, citrates, acetates and formates in special baths will hold enough lead in solution to severely affect the deposits. The top permissible limit is 0.002 oz/gal. (0.015) g/l.

Electrolysis at 2-3 amp/sq.ft. cathode current density is effective in its removal.

Zinc and cadmium. Small amounts of zinc, 0.007 oz/gal. (0.05 g/l), have been used as brighteners in nickel solutions, but the resulting deposits are porous and appreciably embrittled. Higher concentrations cause the deposits to become dark. In bright nickel solutions, zinc causes dark plate to be deposited at low current density. Cadmium is used as a brightener in amounts of 0.012-0.067 oz/gal. (0.1-0.5 g/l).

Both cadmium and zinc are removed selectively by electrolysis at 2-3 amp/sq.ft.

Iron. In years past when only 90 or 92% anodes, containing several percent iron, could be purchased, the plater was not called upon to apply heavy nickel deposits, to produce bright work directly from the bath or to chromium plate over the nickel. We can recall a nickel solution containing 2 oz/gal. of iron and 2 oz/gal. of nickel in which spoons were being plated satisfactorily. As plating speed and temperature were raised, difficulties were experienced with brittleness and pitting. In modern bright plating solutions, the limit for iron content is about 0.01 oz/gal (0.07 g/l). Above this concentration, it causes dull deposits which are stressed beyond safe limits. The adhesion is also poor. For example, a bright nickel of 588 Vickers hardness showed a Vickers of 687 after

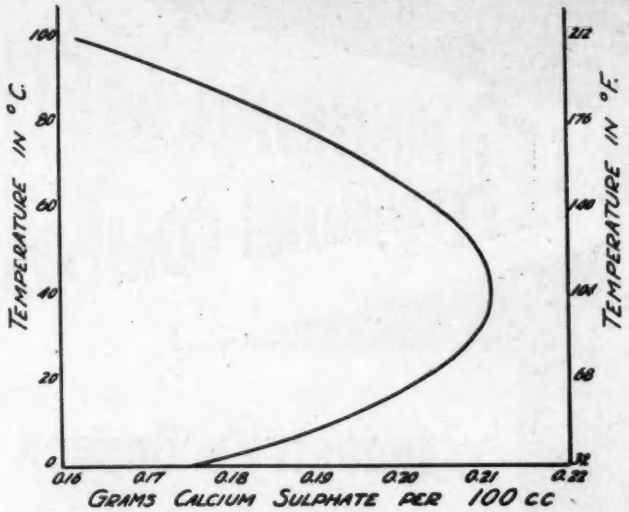

Fig. 2. Solubility of calcium sulfate in nickel plating solution.

only .05 oz/gal. (0.38 g/l) of iron had been added to the bath.

To remove iron, raise the pH of the bath to above 4.7 electrometric, add one pint of 100 volume hydrogen peroxide to each 100 gallons of hot solution and filter. It can also be removed by electrolysis at a cathode current density of 5 amp/sq.ft.

Arsenic in small quantities produces a brightening effect, but the deposits are somewhat brittle. Such deposits are peculiar in that they turn black on heating, e.g. in soldering.

Liscomb's method has been used successfully to remove arsenic.

Calcium can be present in nickel solutions to the point of saturation without causing harm. In modern hot bright nickel solutions where evaporation losses are high, difficulty has been encountered many times because of precipitation of calcium sulphate. This salt is unique in that its solubility decreases with increasing temperature. The solubility curve is shown in Fig. 2. Calcium sulphate which has precipitated on articles being plated, causes pit-like depressions in the deposit. It also precipitates on electric immersion heaters, causing them to overheat and burn out.

The best control method is to prevent its entrance into the solution by the use of deionized water.

Magnesium is not harmful in most nickel plating solutions. It has been used in concentrations of up to 2 oz/gal. (15 g/l) in a commercial bright cobalt-nickel bath. This addition lowered the Vickers hardness from 588 to 398. It also softens deposits produced in ordinary nickel solutions and increases ease of buffing, conductivity and throwing power.

Aluminum salts have been added to bright nickel baths operated in a medium pH range with no observable detrimental results. If the pH should rise above the precipitation point for aluminum hydroxide, however, the salts will hydrolyze, and the hydroxide settles on the cathode causing porosity. Incomplete coverage has also been observed.

To remove aluminum, raise the pH to 5.0 to precipitate hydroxide and filter.

Sodium, potassium and ammonium ions in uncontrolled concentrations are considered impurities in modern bright nickel baths. They tend to increase hardness and brittleness. The ammonium ion also produces white clouds in some bright nickel deposits. In an 18% cobalt-nickel alloy bath, a change of the buffer from sodium formate to nickel formate in equivalent quantities lowers the hardness from 600 to 558 Vickers.

All three are removed by filtration through materials with zeolitic properties.

Nitrates lower the cathode efficiency, de-

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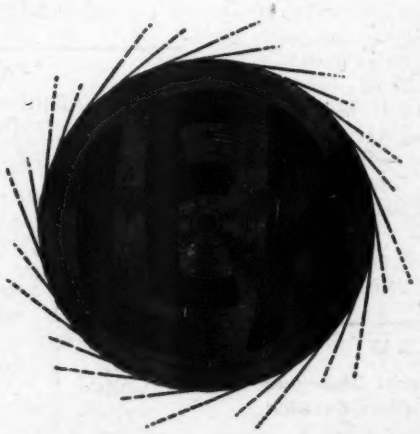

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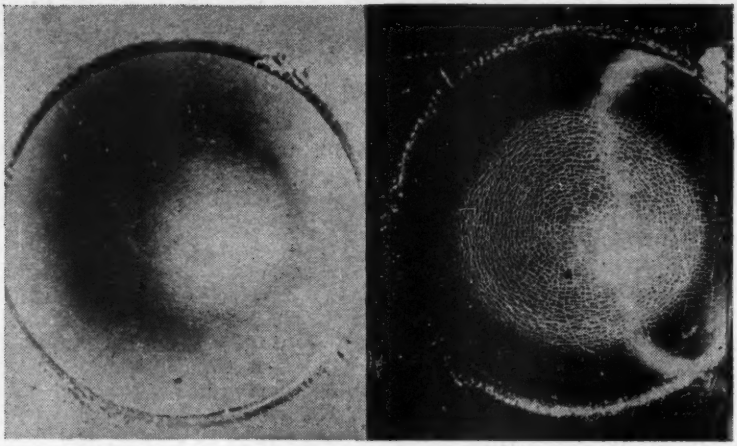

Fig. 3. Effect of extract from unwashed filter bags on Olsen draw cup. Left: crack free ductile deposit from pure solution. Right: cracked brittle deposit from contaminated solution.

crease throwing power and cause pitting. In cobalt-nickel baths, nitrates restrain deposition of nickel.

Make the solution acid with 2 cc/gal. of sulphuric acid and plate on dummy copper cathodes to reduce nitrates to ammonia.

Hexavalent chromium lowers the cathode efficiency and causes spotty and poorly adherent deposits. As little as 0.0013 oz/gal. (0.01 g/l) decreases the efficiency by 8%. At 0.01 oz/gal. (0.090 g/l), nickel does not deposit (Tables IX and X).

Treatment with lead salts such as lead carbonate or acetate, added in carefully calculated quantities, causes precipitation of lead chromate.

Organics from water, tank linings, rack materials, paints, oils, buffing dirt, molds, salts, etc. show effects on high, medium or low current density areas. They darken the deposits, cause them to become ridged or spotty, and lead to pitting and brittleness (Fig. 3).

Carbon treatment for removal of organics is generally effective at normal bath pH,

TABLE IX

Effect of Hexavalent Chromium in Cold Nickel Plating Solution

Chromium g/l	Appearance of Deposit	Nominal Cathode Efficiency, %
0.010	Normal	88
0.020	Normal	60
0.040	Normal	30
0.050	No Adhesion	—
0.070	No Adhesion	—
0.090	No Deposit	—

TABLE X

Effect of Addition of Hexavalent Chromium to Plating Solutions

Addition: 0.150 g/l Cr

Solution	Appearance of Deposit	Nominal Cathode Efficiency, %
Acid zinc	Normal, fair adhesion	100
Cyanide zinc	Sl. milky, poor adhesion	100
Alkaline copper	—	0
Nickel	—	0
Acid copper	No adhesion, peeled	—
Cyanide gold	Dark shade	60-80
Brass	—	0
Cadmium	Uniform on copper, spotty on steel, poor adhesion	100
Cyanide silver	Normal	100

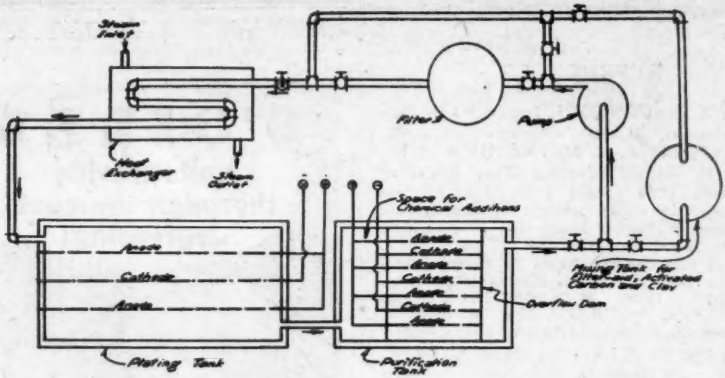

Fig. 4. Typical continuous purification system for cobalt-nickel electroplating processes.

but sometimes a pH of around 2.0 is required. Often a preliminary oxidation with hydrogen peroxide is effective. An activated clay treatment is useful in cases where carbon fails; it has a zeolitic as well as an adsorptive action. Another method makes use of electrolysis at a current density at which organic matter tends to be codeposited, as indicated by preliminary bent cathode tests.

Continuous Purification of Bright Nickel Solutions

Where unusual contamination is encountered, the installation of a continuous purification system for bright nickel solutions is desirable. It permits the production of consistently good nickel deposits, 24 hours a day, 7 days per week. The solution can be kept free from all organic and metallic contamination at all times. It may not be advisable to use continuous purification with certain bright nickel plating processes as there may be an excessive loss of organic brightener.

The purification system is installed adjacent to the plating tank as illustrated by Fig. 4. An auxiliary tank is fitted with anode and cathode rods having relatively close anode-cathode spacing. The same type of nickel anodes are used as in the main plating bath. The cathodes consist of corrugated iron sheets, woven steel wire or ordinary steel sheets. The current density in the purification tank should average about 5 amp/sq.ft., the current density range for purification being from 2 to 5 amp./sq.ft. The number of ampere-hours required through the purification tank can be stated in terms of the volume of plating solution and the number of hours it is operated daily. Under extreme conditions, 0.05 ampere-hour per gallon of plating solution per hour of operation has been found sufficient. In all cases, a minimum of 0.02 ampere-hour per gallon of plating solution per hour of operation should be provided.

For example, with a plating solution of 1000 gallons operated 8 hours a day, the maximum requirement would be 0.05x1000 x8=400 ampere-hours. If the purification tank is operated 8 hours a day, it will therefore require 50 amperes. The cathode area in the purification tank should be 50/5 =10 square feet.

The circulation through the purification tank should permit turning the plating solution over at least once every three hours.

If metallic impurities are not present or have been removed by selective electrolysis, organic impurities can be removed in certain bright nickel solutions without adsorbing any essential ingredients of the bath by charging the filter with 1 pound of activated carbon and 1 pound of activated clay for every 100 gallons of solution, in large installations by continuous feed. The carbon should be renewed after each 48 hours of operation.

There are many omissions in the impurity removal methods suggested in this paper. Project No. 5, now being carried out by the Research Committee of the A.E.S.,

will contribute materially to our knowledge of this subject.

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3. L. E. STOUT, O. G. BURCH and A. S. LANGSDORF, Electrodeposition of Copper-Nickel Alloys, *Trans. Electrochem. Soc.* 57, 113-30 (1930).

NICKEL PLATING SYMPOSIUM

(*Continued from page* 510)

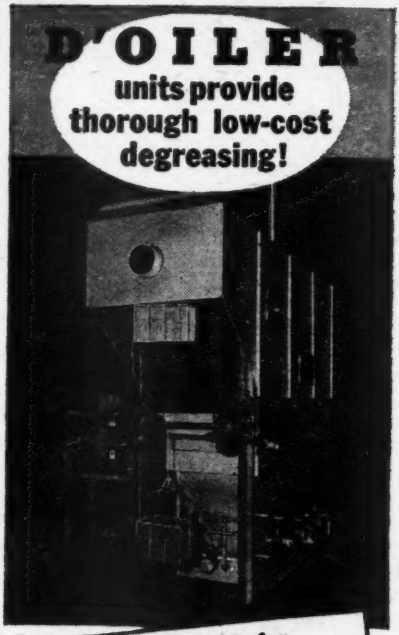
Speaker from the floor: We have prepared Watts type baths and all-chloride baths from chemically pure salts and found that the properties of the deposits, which were 99.99% nickel, were what you would expect. The absence of the cobalt did no harm.

Question: Have the terms bright, semi-bright, matte, dull, etc. been standardized?

Mr. Pinner: No.

Question: What is the best type of agitation in the all chloride bath?

Dr. Wesley: It is safe to say that the main factor is the rate of movement of the solution relative to the metal surface. It doesn't matter whether the work or the solution is moved. In the experiments with very high current densities, it was impractical to move the steel at a thousand feet per minute since we did not have a continuous strip line to experiment with. We simply moved the solution at a thousand feet per minute. I don't advocate that you try to move your work at that rate without considerable planning.



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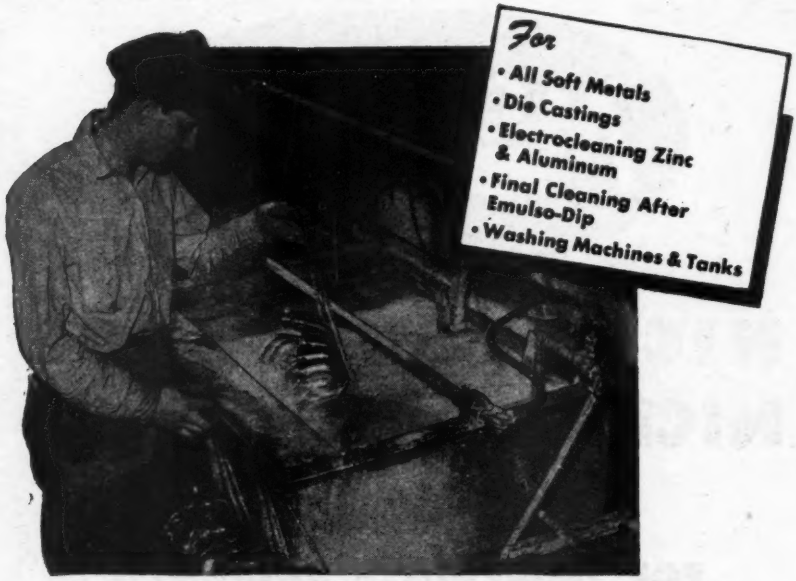

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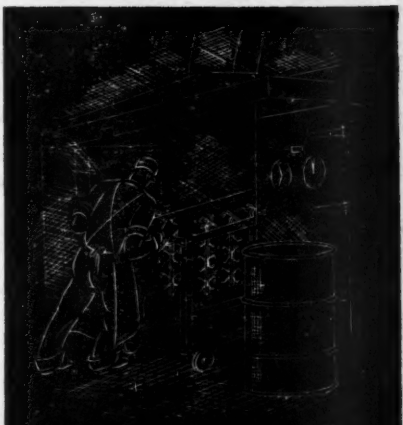

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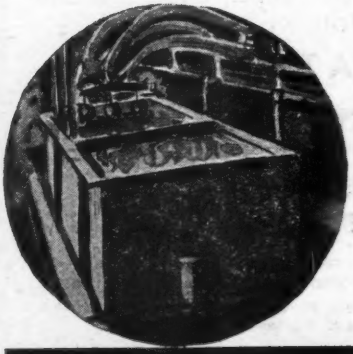

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Industrial Gas **24**, 22 (January 1946).

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The Quality of Terneplate

J. Soc. Public Analysts (Jan. 1945); Tin and Its Uses **16**, 11-12 (Sept. 1945).

Select a sample of known area to give a coating weight of not more than 0.8 gram, degrease, dry and weigh. Attach to a nickel wire and immerse in 100 ml of stripping solution. When coating is dissolved, quickly remove loose deposit, keeping specimen immersed. Remove clean steel, wash, dry and weigh. Transfer solution with deposit and washings to a conical flask, connect to a supply of carbon-dioxide and boil for 10 minutes. Cool, dilute with 100 ml of water and add 5 ml of 1 per cent starch solution and 1 ml of 10 per cent potassium iodide solution. Titrate with N/20 potassium iodate. The iodate should be standardized against a mixture of tin and lead, in approximately same proportions as in terneplate, dissolved in stripping solution and treated as above.

Improvements in the Potentiometric Titration of Chlorides

ROBERT P. YECK and G. H. KISSIN. *Ind. Eng. Chem.* (Anal. Ed.) **17**, 692-693 (1945).

A simplified electrode system without a salt bridge is described. The assembly consists of a metallic silver electrode and a reference electrode reversible to chloride ions, mounted with a stirrer in a compact unit. The method makes possible titration of chloride ion with silver nitrate solutions to an abrupt potential swing at the equivalence point detected with an electronic voltmeter, resulting in a simplicity and convenience comparable to conventional redox electrometric titrations. Use of an electronic voltmeter for detection of the end point eliminates errors of polarization and makes possible routine potentiometric titration of chloride in solutions containing heavy metal ions. Eight references.

Nickel Flashing and Its Relation to Enamel Adherence

EUGENE WAINER and W. J. BALDWIN. *J. Am. Ceramic Soc.* **28**, 317-326 (1945).

Nickel flashing as applied to enameling stock is shown to be primarily metallic

nickel. The role of nickel in developing enamel adherence is apparently bound up with the retardation of oxidation which the nickel flash imparts in the enameling cycle. The problem of adherence may be considered to be corrosion of the iron by action of gases and other agents which may be present at enameling temperatures. With cover coats directly on iron, the amount of nickel required will vary with each particular enamel composition. Some evidence as to the nature of adherence-promoting oxide is presented.

Process Control for Anodizing Aluminum

Am. Machinist **89**, 137, 139 (Dec. 6, 1945).

For maximum protection, it is best to anodize after the parts have been completely machined, welded or otherwise worked to the point of application of paint. The film insures good adhesion of paint and can be dyed if desired. If paint is to be applied, a zinc-chromate primer is sprayed upon the film soon after rinsing and drying of the anodized pieces.

Anodizing of Aluminum Alloys III Conclusion

RAYMOND J. KWASNIK. *Die Casting* **3**, 68, 70, 72, 74 (Nov. 1945).

Various electrochemical finishes for aluminum alloy die castings other than anodic coatings are discussed, with particular reference to proprietary pre-plating procedures, plating, chemically created oxide films, painting and lacquering.

Chemical Treatments for Zinc Alloy Die Castings III

Die Casting **3**, 62-64, 66 (Nov. 1945).

Phosphate treatments are discussed.

Electropolishing of Metals

CHARLES L. FAUST. *Ind. Aviation* **3**, 20, 59-61 (Dec. 1945).

Processes are discussed which include the use of such solutions as mixtures of perchloric and acetic acids, sulphuric and citric acids, phosphoric acids and certain alcohols, phosphoric acid and glycerine, sulphuric and hydrofluoric acids, and sulphuric and phosphoric acids.

The Anodic Treatment of Magnesium Die Castings

F. A. ROOT. *Die Casting* **3**, 64-66, 68 (Dec. 1945).

New method of protective treatment for magnesium alloys are evaluated and compared with the hydrofluoric acid-dichromate chemical treatment. Comparison of corrosion protection afforded, color and thickness of coatings, hardness and other comparative data are included.

Nickel Dipping

G. H. McINTYRE. Enamelist **23**, 13-20 (Jan. 1946).

The author stresses the importance of control of acidity, the permissible acidity ranges, the permissible ranges of the pertinent operating variables, and the general effects of nickel treatment in relation to blue ground coat and particularly for application of white directly to steel.

Automatic Multiple-Dip Pickling

JOHN E. HYLER. *Tool Eng.* **15**, 38-39 (Dec. 1945).

Timed immersion and automatic dip and lift from tank to tank, insure a correct, predetermined interval in each solution.

Processing and Fabrication of Stainless Steel Sheet and Plate Products III

H. S. SCHANFUS and T. C. CLINGAN. *Steel Processing* **31**, 770-773 (1945).

Descaling of chromium-nickel materials, types of scales, scale removal, production descaling procedures, descaled surfaces, equipment and process control are covered.

Selection of Metal Cleaning Methods

CHARLES DELMER TOWNSEND. *Materials & Methods* **22**, 1411-1417 (1945).

Factors which must be studied are: type of metal to be cleaned; its surface condition; degree of cleanliness required for subsequent surface treatment; shape, size and fragility of the part; required production rate; condition of the part for the next operation — whether wet or dry, hot

or cold; available heating medium for the solution; and available floor space.

Surface Finishing of Beryllium Copper

Iron Age **156**, 60-63 (Nov. 15, 1945).

Beryllium copper components benefit when given electroplated finishes satisfactory for other copper-rich alloys. Details are presented of numerous acid solutions for removal of oxide scale, with particulars of treatment in sulphuric acid followed by acid dichromate processing. Cleaning, specifically for electroplating, is also discussed.

Electrostatic Spraying of Porcelain Enamels

JAMES B. WILLIS. *Steel* **117**, 118-120, 162, 165-166, 168, 170, 173, 176 (Nov. 12, 1945).

Appreciable savings in material consumed and uniformly coated products are produced with minimum loss from overspray. The process is valuable in spraying flat surfaces with simple flanges or symmetrical shapes — especially where the operation is highly repetitive. No special preparation of enamel is required, but accurate control of its physical properties is essential. To determine the number and location of guns for most efficient operation involves some experimentation on each installation.

Sodium Hydride Descaling

L. W. TOWNSEND. *Steel* **117**, 122-123, 180, 182, 184 (Nov. 12, 1945).

A bath containing active sodium hydride penetrates stainless steel and uniformly descales all surfaces with no loss of metal and no deleterious effect on structure. Disposal of waste residue is eliminated.

Degreasing Die Castings

ARTHUR P. SCHULZE. *Ind. Finishing* **22**, 32, 34, 36-38, 40, 42, 44 (Dec. 1945).

Review of techniques.

Technique of Sheet Galvanizing by the Hot Dip Process

HAROLD EDWARDS. *Sheet Metal Ind.* **22**, 1914-1921 (1945); Cont'd.

Preparation of the spelter bath, introduction of the galvanizing frame into the bath, typical skimming roll, spelter bath temperature, operating speed, sprays, finishing, properties of the galvanized sheets, uncoated surface, influence of the steel base, and microstructure are covered. Seven references.

FROM THE SECRETARY

Buttons and pins for officers and members of the A.E.S. were authorized at the June 1945 Convention. These are now available, after delays in manufacture occasioned by the war, and Branch Secretaries have been asked to order for their branches.

The officers of the Society have received gold buttons. Past Presidents have received gold buttons with a "Past President" tab. Silver buttons with "Past President" tabs are available for Past Presidents of the Branches of the Society and silver pins with the Society insignia for members of the Society.

(*Continued on page* 554)

The Sodium Hydride Descaling Process

HARVEY N. GILBERT. *Metal Finishing* **43**, 492-495, 533 (1945).

Laboratory developments, source of sodium hydride, typical installation, operating procedure, and advantages of the process are discussed.

New Pickling Room Has Many Features

M. B. SMITH and RICHARD CARNO. *Finish* **2**, 17-18, 52 (Dec. 1945).

Suggestions for those who are building or modernizing pickle room installations.

The Preservative Qualities of Aluminum Paint

Aluminum & Non-Ferrous Review **10**, 38, 40, 42 (July-Sept. 1945).

Aluminum paint is ideal for lamp-posts, refuge posts, sand bins, transformer boxes, sign posts, and similar objects, because it not only protects them from the effects of weather, but also makes them easily visible at night or in dull or foggy weather. Some applications and economies are described.

BOOK REVIEWS

By DR. HAROLD J. READ
Associate Professor of Metallurgy
The Pennsylvania State College

SURFACE ACTIVE AGENTS—THEORETICAL ASPECTS AND APPLICATIONS by C. B. F. Young and K. W. Coons. X+381 pages. Chemical Publishing Co., Inc., Brooklyn, N. Y. Price $6.00.

First impressions are always powerful factors in the formation of an opinion and it would seem that authors should be particularly careful to eliminate errors in at least the first few pages of their writings. Not even this precaution has been taken in the present instance. If the book possesses any merit at all, it is badly obscured by a steady procession of errors and redundancies which begins in the very first pages of the first chapter.

We find, for instance, that on p. 6 the mathematical expression defining surface tension is incorrect. In view of the fact that the entire book centers around the concept of surface tension, it does not appear to be unreasonable to expect that some care should have been taken in stating its definition in mathematical form.

In the course of the explanation of an equation on p. 9, several references are made to the lettering in Fig. 3. It is not particularly helpful to find that Fig. 3 is utterly barren and devoid of any lettering.

The work of Buehler on the relationship between surface tension and viscosity is referred to on p. 10, and his equation presented. The authors apparently found particular interest in this item because it is repeated on p. 12. They are at least consistent in both their enthusiasm and their carelessness, since, while there are at the end of the chapter two separate but neighboring references to the same original journal article for the duplicated passages, Buehler's initials are given as C. A. in one and C. H. in the other. Proofreading, wherefore art thou!

Here then are three highly objectional mistakes in the first few pages of the text. They are errors which any critical reader would have noticed at once, even without knowledge of the subject matter. From this, would it not be reasonable to suspect that the remainder of the book follows the same slipshod pattern? Yes, and it does. Is it to be expected that the reader would place any reliance on those portions of the book of which he has no personal knowledge when he can recognize so many errors? Very unlikely. Then why should such a book be published? That *is* the question. Why, indeed?

Any publisher who undertakes to present to the public a scientific textbook or monograph accepts the heavy moral responsibility of producing a work which is authoritative, accurate and free of typographical errors. In other words, his responsibility is on a par with that of the author, and censure for the production of a volume such as that presently under review must be directed at both parties. It is, however, the duty of the publisher alone to have as a part of his organization capable individuals who can pass both upon the qual-

ifications of an author and the worth of his manuscript. Realization of this duty is apparently lacking here. Let it be added that these remarks arise not wholly from this single book now being considered, but rather from the evaluation of a regretable series of publications.

A short chapter of ten pages is devoted to the use of surface active agents in plating, metal cleaning, pickling and etching. It is a rambling, inadequate discussion marred both by the usual minor, careless errors and by a neglect of much available and pertinent information. This chapter and the discussion of the methods for measuring surface tension in the second chapter are the only items of direct interest to the practical electroplater who chooses to put his trust in this book.

The reviewer has shown the book to a jury of his colleagues, and the unanimous verdict against publisher, authors and book is short.

Thumbs down. R. I. P.

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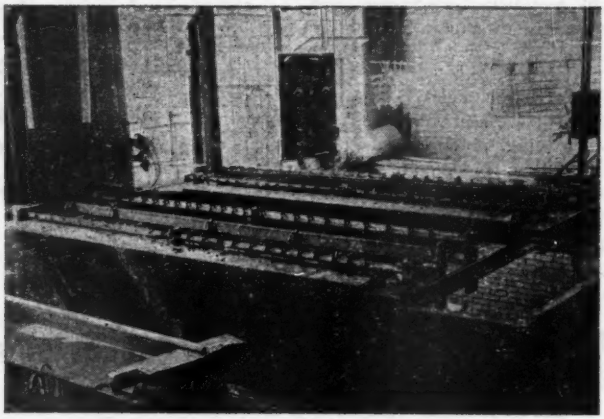

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ADELAIDE BRANCH

The February meeting was held in the Liberal Club Buildings, North Terrace, on Wednesday 13, President W. J. Blanch in the chair. Thirty-five members attended.

The meeting took the form of a Quiz Night and most members entered into the discussion of the problems presented.

The Programme for 1946, drawn up by the Technical Committee, is as follows:

March —
Plant Visit to British Tube Mills
April —
Hard Chrome Plating — Mr. Williams
May —
Rectifiers and Generators — Mr. Greenfield
June —
Barrel Finishing — Mr. Donnan
July —
Anodizing Aluminum — Mr. I. Wiles
August —
Solution Analysis — Mr. M. Boyce
September —
Silver Plating—Speaker to be announced
October —
Plating of Die Castings — Mr. Gannon
November —
Bright Nickel Plating — Mr. Andrews
December —
Annual Dinner

G. DIXON, *Secretary*

BALTIMORE-WASHINGTON BRANCH

The April 5 meeting was held at Reichhart's Restaurant in Baltimore. Twenty-seven attended the dinner, forty-six the meeting.

Routine business was carried on during the dinner hour. The Committee for the solicitation of National Convention papers, having completed its job, was discharged with a vote of thanks. Abner Brenner announced that most of the missing numbers of THE REVIEW to complete a permanent file at the Baltimore Enoch Pratt Free Library, were available at the Bureau of Standards. The Committee on Convention Exhibits was continued in office to cover the Convention period. L. G. Tubbs reported as Chairman of the Branch Research Fund Committee.

The encumbent officers gave a summary report on their past year's work.

There was one election to membership and one resignation.

Tom Slattery, Chairman of the Nominating Committee, announced the recommendations for officers during 1946-1947. The Branch agreed and elected the following: President, Abner Brenner; Vice President, Robert G. Guerke; Secretary-Treasurer, L. G. Tubbs; Librarian, Nathan E. Promisel.

After a short acceptance speech by the newly elected officers, President Brenner took the chair.

The following were elected to represent the Branch at the coming National Convention in Pittsburgh: Delegates — Abner Brenner and Robert D. Guerke. Alternates — Thomas S. Slattery, L. G. Tubbs and V. A. Lamb.

In the absence of the newly elected Librarian, Walter Olson introduced Mr. John Kreml, Research Chemist with the Rustless Iron and Steel Division of the American Rolling Mill Co., as the speaker of the evening. Mr. Kreml read an excellent paper on the "Electrolytic Polishing of Stainless Steels". After the talk, he gave a working demonstration of the Rustless Process and answered a number of questions from the audience.

ALBERT G. TAYLOR, *Sec'y-Treas.*

BOSTON BRANCH

Boston Branch met on Thursday, April 4, at the Statler Hotel, with President Callahan in the chair.

One application was read for the first time. Another was read for the second time, approved by the Board of Managers and the applicant was elected.

There being no speaker the Branch held a discussion of the Branch By-Laws lasting until 11 P.M.

A. W. GARRETT, *Sec'y-Treas.*

CHICAGO BRANCH

The regular monthly meeting was held in the Hamilton Hotel on Friday, March 8, with 93 in attendance.

The speaker of the evening, O. Kocour of Kocour Co., Chicago, gave a very interesting and instructive talk on "Tests for Plating Solutions". He demonstrated a number of instruments for testing solutions and answered many questions.

M. H. LONGFIELD, *Secretary*

GRAND RAPIDS BRANCH

The Grand Rapids Branch held its monthly meeting at the Rowe Hotel on March 8 at 8:00 P.M.

Three applications were presented to the members, and the applicants were elected to membership.

An instructive paper dealing with "Cleaners and Cleaning Methods prior to Electroplating and Painting" was read by Mr. Leroy Camel of the Detrex Corporation. It contained much valuable information and was well received by the members.

RANSOM B. PERKINS, *Secretary*

HARTFORD BRANCH

Twenty-five attended the chicken dinner which preceded the regular February meeting in the Egyptian Room of Hotel Bond.

Following George Hogaboom's brief discussion of "Latest Developments", Ralph McCahan, Technical Chairman for the evening, introduced the speaker, Mr. C. H. Sample of Rheem Research Products, Inc., Baltimore, Md., whose subject was "Corrosion Tests". Mr. Sample, formerly of the Bell Telephone Laboratories, had a splendid talk, amply illustrated with colored slides, the like of which have not often been seen before.

The results of the corrosion tests on which Mr. Sample reported were very interesting, some confirming general opinion but more than a few being directly opposite to what is generally believed. The sixty-five guests sat awe-stricken, viewing the beautiful display of slides. Mr. Sample was warmly accorded a rising vote of thanks for a fine talk.

F. W. SMITH, *Secretary*

HARTFORD BRANCH

The March open meeting was held in the Egyptian Room of Hotel Bond on Monday, March 18.

After President Harry Sanders had called the meeting to order, George Hogaboom presented his regular monthly feature "Latest Developments".

The speaker of the evening, I. Laird Newell of Henry Souther Engineering Co., Hartford, was then introduced by President Sanders. An active member of the Hartford Branch and Chairman of its Educational Committee, Mr. Newell is well known to all the members. His talk on "New Methods and Equipment Used in Research and Testing of Electrodeposits", was timely and well presented. The instruments discussed were the Brush Analyzer, the spectrograph, X-Ray diffraction equipment and the Hull Cell.

The members enjoyed Mr. Newell's talk very much and expressed their appreciation by a rising vote of thanks.

F. W. SMITH, *Secretary*

LOS ANGELES BRANCH

Sixty members were present at the March meeting held at the Hotel Cabrillo, 11th and Broadway, on March 11. The visitors were: George M. Kent of the U. S. Navy, Dennis Noor of Sundmark Supply Co., C. N. Beil of Master Record Production Co., George G. Skinner of New West Coast (*the Editor is concerned about what has happened to the Old West Coast*), Thomas H. Good of Able Chrome Plating Co. and R. W. Warner of Los Angeles Plating Co.

The Branch then held its General Question and Answer Session for the year, with

many interesting points brought out and debated by the members present.

One application was received and referred to the Board of Managers. The Secretary read a letter from Mr. W. J. Blanch from the new Adelaide (Australia) Branch, and the members thought so well of the letter that they requested the Secretary to make it available in THE REVIEW. The Secretary was requested to write direct to the Adelaide Branch giving the necessary transfers and advising the transferred members that their unpaid dues for the war period had been cancelled.

Mr. Lamoureux reported that an active campaign for solicitation of sustaining memberships is being conducted by members Drake, Eldred, and Holman. A report will be submitted at the April meeting.

Mr. Rynkofs reported for the Banquet Committee that all matters were well in hand. He advised those who had not yet made reservations to do so as the number of seats were limited.

FRANK J. BUNKER, *Sec'y-Treas.*

NEW HAVEN BRANCH

The regular monthly meeting held in the Hotel Taft on March 12, was well attended.

President Walter T. Lynch presided and brought the members up-to-date on the plans for the Regional Convention.

The members present kept one minute's silence to honor the late Robert E. Mooney whose death is mourned by all.

President Lynch introduced the speaker, Robert R. Sizelove, Technical Director of The Frederick Gumm Chemical Co., Kearny, N. J. "Engineering a Bright Nickel Plating Installation" proved an interesting subject for these busy reconversion days. Mr. Sizelove, with the use of charts, covered his subject thoroughly and gave the platers complete technical and engineering data for efficient installations.

B. J. GAFFNEY, *Secretary*

NEW HAVEN BRANCH

The New Haven Branch held its monthly meeting on April 9 in the Sterling Chemistry Laboratory of Yale University.

Following the presentation of the film "Die Casting", Technical Chairman Edgar W. Luther introduced Mr. E. A. Anderson of the Research Division, New Jersey Zinc Co., who spoke on "The Finishing of Zinc Base Die Castings". The speaker brought the platers up-to-date with a resumé of finishing procedures for zinc die castings as used before the war, and of the technical advances made since. Having spoken of his own personal experience, Mr. Anderson opened a Question Box period which proved very informative. Joseph Downes and William Cullen lead in the discussion.

B. J. GAFFNEY, *Secretary*

ST. JOSEPH VALLEY BRANCH

The regular monthly meeting was held in the Empire Room of Hotel Elkhart on February 6. Dinner was served to 43 members and guests at 7 P.M.

There was an attendance of 55 at the business meeting which was opened by President Lockerbie at 8 P.M. He introduced several guests from the floor.

There was one election to membership.

Messrs. Weeg, Brady and Ray were appointed a Nominating Committee to select a list of prospective candidates for office during the coming year. This list will be presented at the March meeting along with any nominations made from the floor.

The President announced that the members in good standing would receive copies of the publication "Kalends". A charge of 4c will be paid from the treasury for each copy. Mr. Harlan gave a detailed description of the purposes and advantages of receiving "Kalends" which is distributed through the Engineering Society of St. Joseph County. He also extended an invitation from the Engineering Society to the Branch to attend a party in South Bend on February 16.

The President announced that notice has been received from the Executive Secretary that in order to get a permanent charter, it is necessary to vote on it in a regular meeting. A motion was made and carried that a permanent charter is desired by the Branch and should be presented at either the April or May meeting — the April meeting being preferred. The Secretary was instructed to notify the Executive Secretary of this action.

The meeting was then turned over to Mr. Wysong who announced the speakers for the March and April meetings.

Mr. Fabry of the Belke Manufacturing

Company was then presented. He read a very interesting paper on "Rack Insulation and Stop-Off". His paper opened with a review of the history of insulating racks and continued with a discussion of the various methods used during the years. He gave a detailed description of the materials and methods which are found to be most practical at the present time. An informal question and answer period followed.

GEORGE A. BOCK, JR., *Secretary*

ST. JOSEPH VALLEY BRANCH

Forty-five members and guests attended the dinner which preceded the Technical Session on March 6 at Hotel Elkhart.

The meeting was opened by President John Lockerbie who introduced new members and guests from the floor. The names of the transferees from the Chicago Branch were read — including Messrs. Brady, C. McDowell, Wysong and Bock.

Kenneth Harlan led a discussion regarding the meeting place for our regular monthly meetings for the coming year. By a majority vote it was decided that the meetings for next year be held in Elkhart on the first Wednesday in every month as heretofore.

Leonard Weeg, Chairmen of the Nominating Committee, then read the list of nominations, as follows: President, Kenneth Harlan; 1st Vice President, Chester McDowell; 2nd Vice President, James Hedges; Secretary, Leonard Weeg; Treasurer, Raymond Friend; Librarian, Harold Wiesner; Board of Managers — Victor Peterson, Theodore Shafer and Forest Robinson.

The report of the Nominating Committee was accepted. Further nominations and election of officers will be held at a future meeting.

An announcement was made of the exhibit at Pittsburgh. Anyone wishing to make an entry was asked to contact Leonard Weeg or Fred Craven.

Mr. Wysong then introduced the speaker of the evening, Mr. Ross Lyons of Hanson-Van Winkle-Munning Company. He gave a very instructive talk on "Power in the Plating Room", dealing mostly with rectifiers and generators and their good and bad points. A short question and answer period followed which was of benefit to all.

GEORGE A. BOCK, JR., *Secretary*

SYDNEY BRANCH

The regular meeting took place at the Chamber of Manufacturers on March 12 with 30 members and visitors present. Four applicants were elected and initiated. The evening then took the form of a question box conducted by E. J. Wright. The following are some of the questions asked and the answers:

Q. 1. Is it possible to get a commercial finish of chromium over cadmium? A. No, not commercially, as the chromium solution will attack the cadmium.

Q. 2. How would a cyanide gold solution be prepared from gold chloride? A. Precipitate with ammonia to produce gold fulminate.

Q. 3. Can common salt be used in a nickel bath instead of nickel chloride. A. Sodium chloride is unsatisfactory as it makes the plate too brittle.

Q. 4 What should be the temperature of a copper cyanide solution? A. Up to 140°F.

Q. 5. What is used for a brightener in a copper cyanide solution? A. Sodium pyrophosphate, ⅛ oz/gal.

Q. 6. Is it possible to copper plate directly onto steel from an acid copper solution. A. No, unless by luck.

Q. 7. What is the best glue to bind emery to a felt wheel? A. Printers' Roller No. 2 pearls.

TWIN CITY BRANCH

There were thirty-nine persons present at the meeting on Monday, April 1 at the Covered Wagon in Minneapolis.

In the absence of President Paul W. Felt, Vice President Gordon W. Lillicrop called the meeting to order and introduced the guests.

The treasurer's report showed a bank balance of $431.44. A letter from the Milwaukee Branch regarding its Annual Educational Meeting was read as well as a letter from the Pittsburgh Convention Committee regarding the attendance at the coming Convention. E. H. Lindemann, Research Fund Chairman, read a proposal

that each member donate one dollar annually to the Research Fund and announced that action would be taken at the May meeting. In the absence of E. R. Frost, Party Entertainment Chairman, G. W. Lillicrop announced the party to be held on June 5 and advised that tickets would be on sale at the May meeting.

A. N. McNeil, Nomination Committee Chairman, announced the following nominations for officers for election at the May meeting: G. W. Lillicrop, President; A. T. Leonard, First Vice President; Paul A. Craig, Second Vice President; and Robert L. Buckley, Secretary-Treasurer.

The door prize for the evening, a leather billfold donated by The Udylite Corporation, was won by Paul A. Craig.

Following the business meeting and a short intermission, Mr. Ralph Pettit of Aluminum Company of America gave a very interesting paper on "Finishes for Aluminum and Its Alloys" and showed slides and movies.

ROBERT L. BUCKLEY, *Sec'y-Treas.*

BRIDGEPORT BRANCH

President H. C. Brown opened the regular monthly meeting on Friday, March 1 with 34 members and guests present.

Wm. Ehrencrona, Regional Meeting Delegate, reported that the date of the 7th Annual Regional Meeting and Banquet had been changed from May 4 to May 11. Bridgeport Branch was to handle the entertainment instead of the Hartford Branch which had assumed charge of program, publicity and banquet.

B. F. Gotthardt, Chairman of the Membership Committee, reported two members for balloting. They were elected later in the evening.

A. R. McNeil, member of the Sick Committee, reported that George Karl was recovering from his illness. Larry Griffin was reported sick and a basket of fruit was sent by the Branch to cheer him up.

Invitations were received from the Hartford Branch to its Open Meeting on March 18 and from the Boston Branch to its 11th Annual Technical Session and Banquet on March 9.

At the end of the business session, a Round Table was arranged between Charles McIlroy, Wm. Ehrencrona, Anthony J. Chenis and R. J. Kwasnik, who discussed various subjects pertaining to metal finishing and answered many questions from the floor.

JOSEPH G. STERLING, *Sec'y-Treas.*

LOS ANGELES BRANCH

The April meeting was held on Monday, April 8, at the Hotel Cabrillo, with 50 members present. The visitors were: Freeman Taylor of Modern Plating Co., R. W. Shill and F. B. Stillings of the Harbor Plating Co., O. G. Smidel of Chicago, Ill., Harry H. Coyle of Liberty Plating Co. and Harold L. deBar of Chemical Engineers. Seven new members were initiated.

E. Lamoureux read a leter from Maurice Caldwell inquiring about the amount of dues paid by the members and whether it had been increased for the purpose of contributing to the Research Fund. It was decided that the Branch buy a sustaining membership for this year out of general funds.

Mr. Rynkofs reported for the Banquet Committee and in his report suggested that the Branch buy an appropriate pennant to be displayed at our meetings and at conventions which our delegates might attend. President Sunderhaus appointed a committee to investigate the pennant situation, consisting of Messrs. Merigold, Bedwell, and Lustutter.

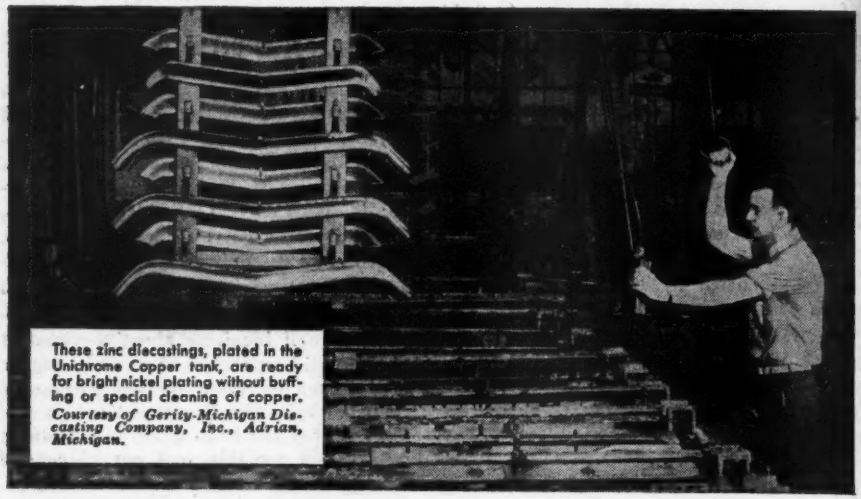
Mr. Bedwell reported on the Industry Meeting to secure G. I. benefits for apprentices of our industry, and advised that the plating industry will be recognized. Bob Gripp was reported ill.

The annual election of officers was held with the following results: D. N. Eldred, President; Howard Woodward, First Vice President; Frank Bunker, Second Vice President; Emmett Holman, Secretary-Treasurer; and Gilbert Extale, Librarian. The following were elected to the Board of Managers: Ed Wells, Chairman, Don Bedwell and Earl Coffin. For delegates to the convention were chosen John Marigold, Marcus Rynkofs and D. N. Eldred, with Emmett Holman, Jack Raskin and Earl Coffin as alternates.

Mr. R. J. Wooley of United Chromium, Inc. gave a very interesting talk on "Unichrome Copper".

FRANK BUNKER, *Sec'y-Treas.*

NO NEED TO BUFF COPPER ON ZINC DIECASTINGS



These zinc diecastings, plated in the Unichrome Copper tank, are ready for bright nickel plating without buffing or special cleaning of copper.
Courtesy of Gerity-Michigan Diecasting Company, Inc., Adrian, Michigan.

...WITH UNICHROME COPPER PLATING

IN one of the largest plating plants in the country, Unichrome Copper again proves it does a top quality job at low cost. Gerity-Michigan Diecasting Company, Inc. does bright plating on difficult work like these zinc die-cast, automobile grille bars . . . without buffing the copper prior to bright-nickel plating. For the Unichrome process deposits a dense plate of exceptional smoothness and luster.

Moreover, Unichrome Copper operates over a wide range of current densities . . . and plates at high speeds. It saves plating time while producing results of highest quality.

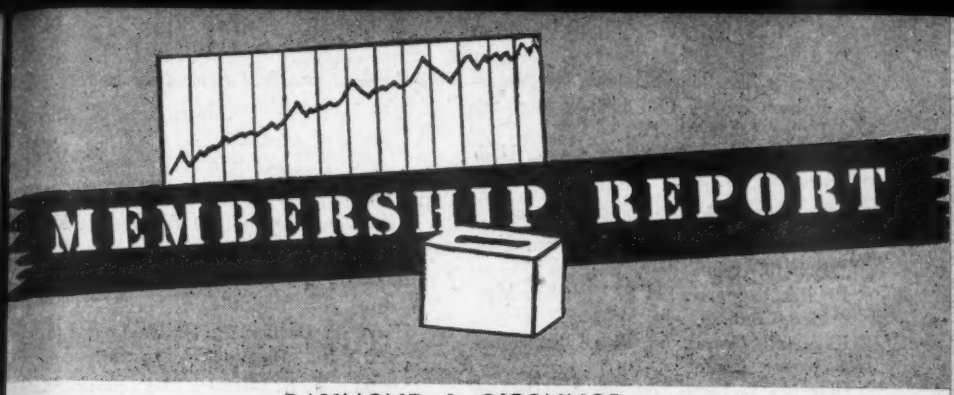
In Unichrome Copper, you will find the right start to the finest chromium plating job on any of the commonly-plated base metals. Write for your copy of the fact-full Unichrome Copper bulletin.

Other Advantages of Unichrome Copper*

- Mildly alkaline—non-corrosive bath easy on racks and equipment
- Non-toxic solution—no cyanide
- Non-gassing—no ventilation necessary
- Moderate temperature operation—cuts down heating losses
- High anode current densities—fewer anodes, clean anodes
- Deposit is clean—requires no activation

A *Unichrome* PROCESS
OF UNITED CHROMIUM, INCORPORATED
51 East 42nd Street, New York 17, N. Y.
Detroit 7, Mich. • Waterbury 90, Conn. • Chicago 4, Ill. • Dayton 2, Ohio

* OTHER U. C. PRODUCTS AND PROCESSES: Chromium Plating • Porous Chromium • *Unichrome Dips • *Unichrome Strip *Anozinc Compounds • *Unichrome Rack Coatings • *Unichrome Stop-Off Lacquers and Compounds • *Unichrome Clear and Pigmented Lacquers • *Ucilon Protective Coatings.
*Trade Mark Reg. U. S. Pat. Off.



RAYMOND J. O'CONNOR
Chairman, Membership Committee

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A. Eder

A. Cardenas

Philadelphia Branch

J. Wesley McCoombe

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M. S. Anderson from Chicago Branch to St. Joseph Valley Branch

Howard N. Beers from Bridgeport Branch to New Haven Branch

Richard T. Haubrich from Bridgeport Branch to Newark Branch

D. P. Volino from Philadelphia Branch to Newark Branch

J. A. Raskin from Detroit Branch to Los Angeles Branch

William D. Gordon from Waterbury Branch to Jackson-Lansing Branch

G. S. R. Walker from Sydney Branch to Melbourne Branch

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George H. Carter from Cleveland Branch to Providence-Attleboro Branch

Edwin J. Smith from Cleveland Branch to Pittsburgh Branch

R. J. Wooley from Detroit Branch to Los Angeles Branch

E. McCoy from Chicago Branch to Twin City Branch

J. Kurdenok from Chicago Branch to Twin City Branch

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Springfield Branch

Louis J. Jenner

Sydney Branch

D. M. McDonald

New Haven Branch

Robert E. Mooney

FROM THE SECRETARY

(*Continued from page* 539)

The silver buttons and pins sell for $1.00 plus 20% federal tax and may be obtained through the Branch Secretaries.

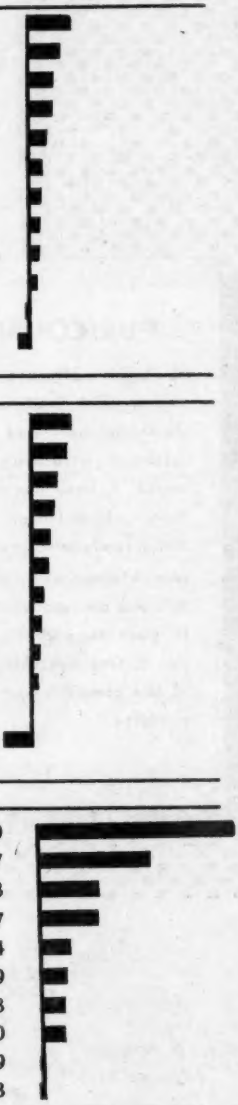
Membership certificates, redesigned as authorized at the June 1945 Annual Meeting, are available at $.50 each for any member desiring them. Some of the Branches have ordered for their members. Members may obtain their certificates from their Branch Secretary.

On November 13, 1945, Branches, through their Secretaries, were requested to advise the Executive Secretary what local library should be used for the *Society publications*, in order that we may be able to set up complete files of our publications in the Branch cities. To date 16 Branches have indicated their desire to participate in this worthwhile activity and it is hoped that replies from all the Branches will be received prior to the June convention.

The "Donate a Volume" request, which has appeared in recent issues of the MONTHLY REVIEW, is bearing fruit. Back volumes of the publications have been received from F. F. Pierdon of Baltimore-Washington Branch, F. C. Mesle of Rochester Branch, Prof. J. T. Burt-Gerrans of Toronto Branch and Jim Hanlon of Chicago Branch for his late brother Frank Hanlon. The family of the late Walter Barrows is donating his collection of back volumes. Several other members of the Society have advised that they will cooperate. Members are urged to advertise this request in order that we may obtain sufficient back volumes to supply libraries in the Branch Cities as well as libraries in other selected cities and institutions. To make its valuable publications available, not only to members, but to others interested in the field of electroplating, is one very effective way of advertising the Society.

MEMBERSHIP CHART

BRANCH	May 1945	Change in Membership	Percent Change
FIRST GROUP			
CLEVELAND	144	+33½	+23.3
LOS ANGELES	151	+27½	+18.2
NEWARK	213	+28½	+13.4
DETROIT	390	+49	+12.6
PHILADELPHIA	154	+15	+ 9.7
BOSTON	157	+10½	+ 6.7
WATERBURY	122	+ 7½	+ 6.1
NEW YORK	191	+10	+ 5.2
HARTFORD	127	+ 6	+ 4.7
CHICAGO.	357	+14	+ 3.9
GRAND RAPIDS	119	— 2	— 1.7
BALTIMORE-WASH.	121	— 7	— 5.8
SECOND GROUP			
PITTSBURGH	80	+17½	+21.9
PROV.-ATTLEBORO	101	+19½	+19.3
MILWAUKEE	107	+15	+14.0
SPRINGFIELD	73	+ 9	+12.3
TORONTO	119	+12	+10.1
ROCHESTER	90	+ 8	+ 8.9
BRIDGEPORT	118	+ 7½	+ 6.4
ST. LOUIS	116	+ 5½	+ 4.7
INDIANAPOLIS	112	+ 4½	+ 4.0
NEW HAVEN	106	+ 3	+ 2.8
BUFFALO	89	....	....
DAYTON	109	—17	—15.6
THIRD GROUP			
ROCKFORD	23	+26	+113.0
SYDNEY	51	+32	+ 62.7
JACKSON-LANSING	63	+21	+ 33.3
TWIN CITY	52	+17	+ 32.7
SAN FRANCISCO	55	+ 9	+ 16.4
TOLEDO	54	+ 7½	+ 13.9
SYRACUSE	57	+ 7	+ 12.3
MONTREAL	54	+ 6½	+ 12.0
CINCINNATI	57	+ ½	+ 0.9
LANCASTER	39	— ½	— 1.3



Membership May 1, 1945 = 3,971
Membership May 1, 1946 = 4,526

Gain in Membership = 555
Per Cent of Gain = 14.0

WONDERBAR

PURICO WONDERBAR has been developed by Puritan to speed up and simplify cleaning and buffing operations. The pre-saponified Tripoli composition gives you a smoother, finer buffing compound that is easily rinsed from intricate patterns and crevices without the necessity of difficult and costly scrubbing.

PURICO API

A highly effective, fast acting acid inhibitor for descaling iron and steel without attacking the metal. A base metal free from embrittlement and dirt is easily and economically obtained with PURICO API. Ask our representative in your territory to give you a free demonstration of this compound on your product.

PURICO ZN

For obtaining a lustrous, long lasting finish on your zinc products, use PURICO ZN. This black oxide finish penerates directly into the metal, thereby eliminating the danger of chipping or flaking off.

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JACOB HAY COMPANY
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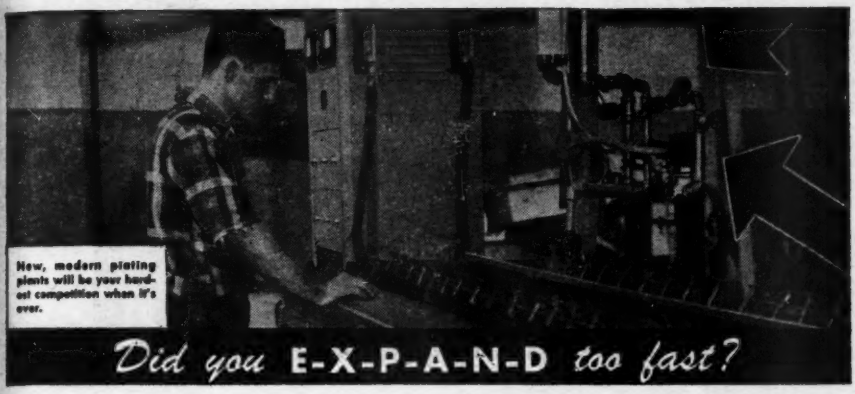

Did you **E-X-P-A-N-D** *too fast?*

The contribution of the plating industry to the war effort will never be completely told. Production was doubled and trebled overnight—without time to engineer the job for efficiency, and with many needed accessories not available.

When it is over, only the more efficient plating plants will survive. Faster plating, more automatic, more exacting tolerances and lower costs will be demanded—and obtained.

These strong statements are based on what we know has been done with Sarco in the past few years. From hot water storage tanks to simple wash tanks, and exacting chrome plating to anodyzing, there is a Sarco temperature control that is inexpensive, easy to install and simple to adjust and operate.

You can speed up production, eliminate rejects and reduce fuel costs by the addition of Sarco equipment to your present installation. The Sarco representative will study your plant — make recommendations—save you time and money without obligation.

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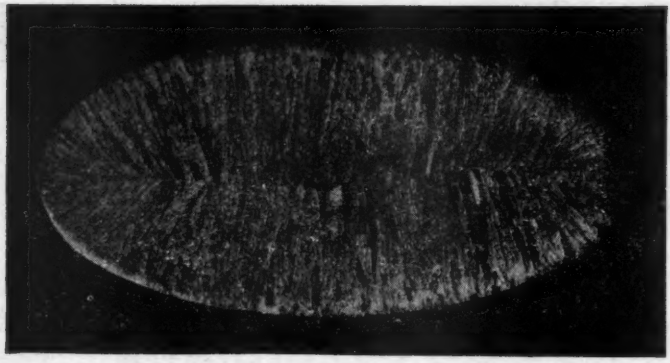

Interlocking Grains

Answer to the Loose Nickel Nuisance

LOOSE nickel in high acid or low pH baths results from intercrystalline corrosion, which isolates the grains before they can dissolve. This is practically eliminated by the spoke-like grain of "Seycast" 99%+ Pure Cast Nickel Anodes.

The long, narrow grains extend to a common center, (see above). As acid can penetrate but a short distance, the grains tend to remain firmly in place during entire corrosion process.

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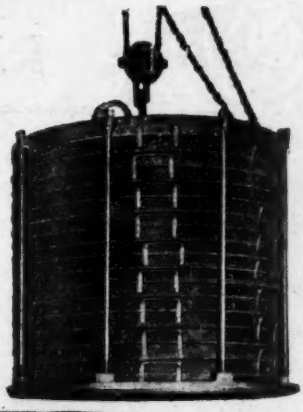

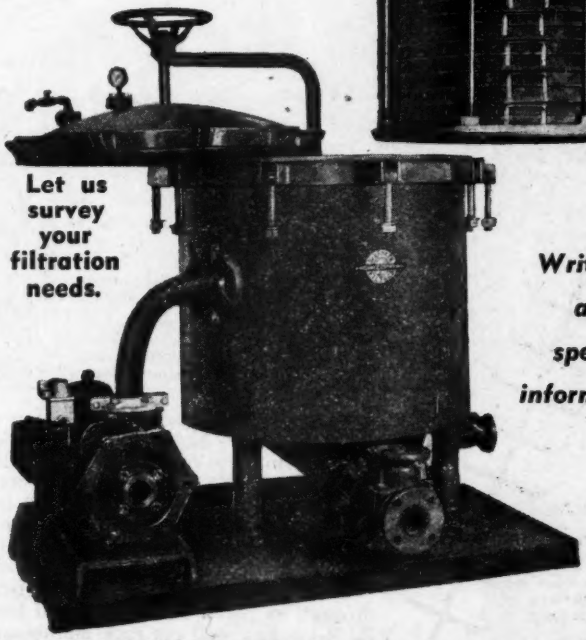

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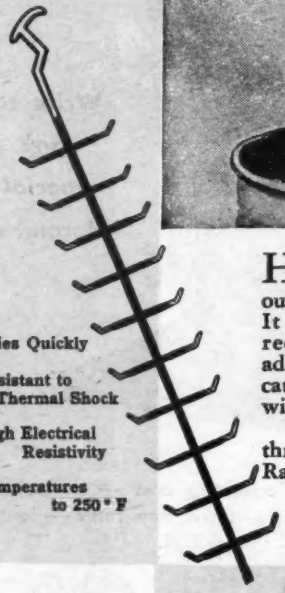

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10 Resistant to Thermal Shock
11 High Electrical Resistivity
12 Temperatures to 250° F

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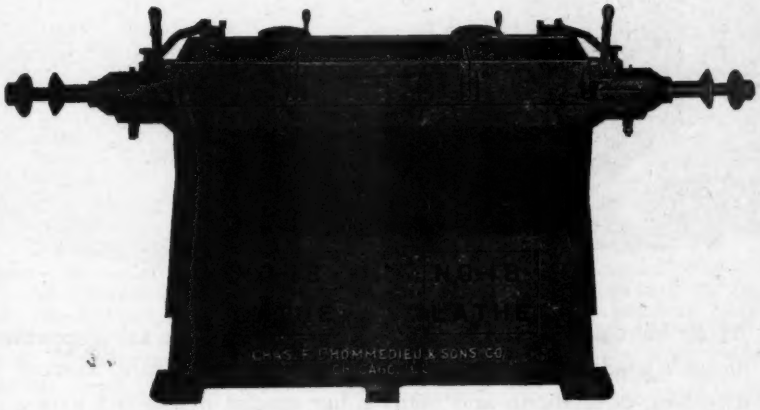

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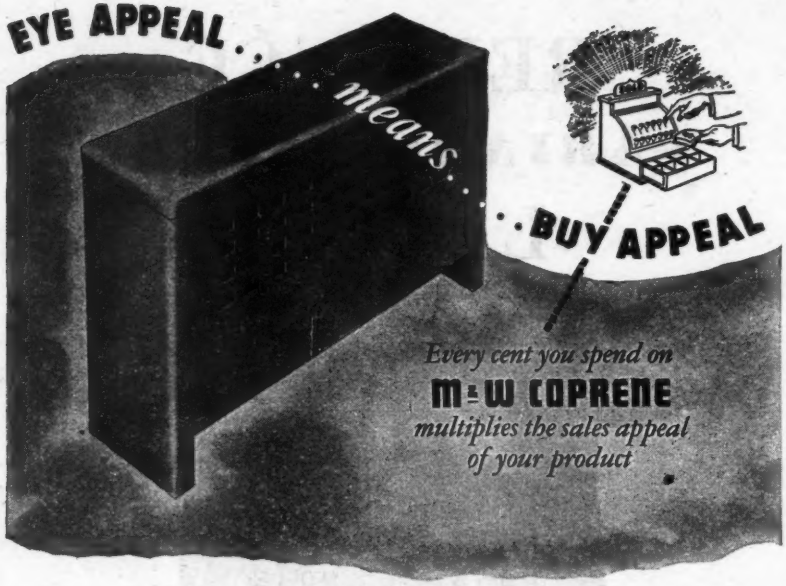

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LOS ANGELES meets second Monday of each month, 6:30 p.m. at Hotel

(Continued on next page)

BRANCH DIRECTORY

(Continued from preceding page)

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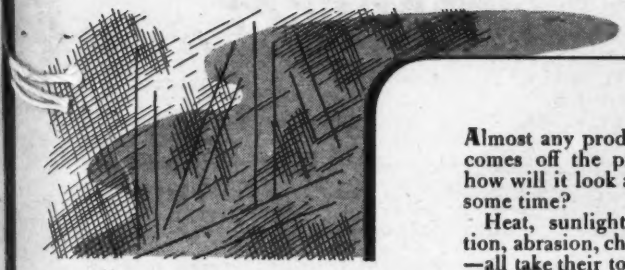

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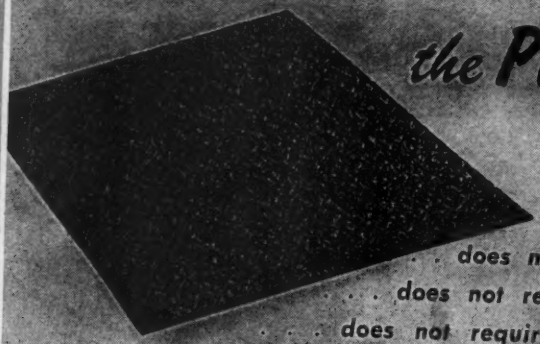

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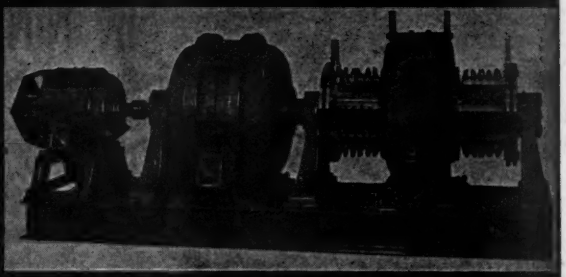

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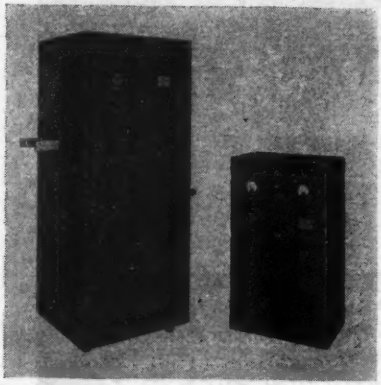

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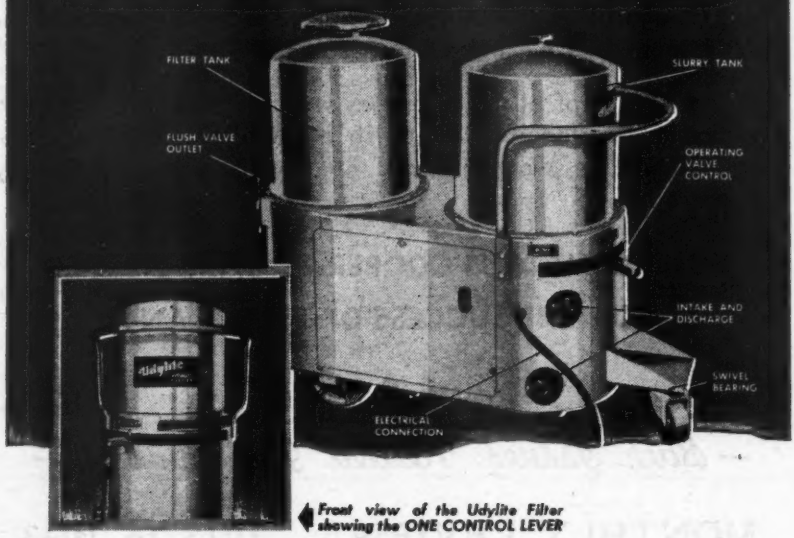

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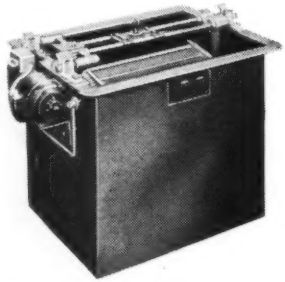

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